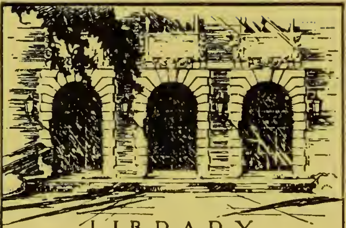

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OF THE
UNIVERSITY OF ILLINOIS

UNIVERSITY OF MONTANA
SCHOOL OF MINES SERIES No 1

Montana State School

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For 1917-1918

BUTTE, MONTANA
APRIL, 1917

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OF THE
UNIVERSITY OF ILLINOIS

UNIVERSITY OF MONTANA
SCHOOL OF MINES SERIES No 1

Montana State School Of Mines

Seventeenth
Annual
Catalogue

For 1916-1917

ANNOUNCEMENTS For 1917-1918

BUTTE, MONTANA
APRIL, 1917

THE UNIVERSITY OF MONTANA

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, March 14, 1913 (effective July 1, 1913).

The general control and supervision of the University are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

MONTANA STATE BOARD OF EDUCATION

S. V. Stewart, Governor........Ex-Officio, President
S. C. Ford, Attorney General........Ex-Officio
May Trumper, Supt. of Pub. Instruction........Ex-Officio, Secretary

C. H. Hall	(1918)	W. S. Hartman	(1920)
J. Bruce Kremer	(1918)	C. E. K. Vidal	(1920)
Leo H. Faust	(1919)	John Dietrich	(1921)
W. H. Nye	(1919)	A. L. Stone	(1921)

Edward C. Elliott, Chancellor of the University

The University comprises the following institutions, schools and departments.

THE STATE UNIVERSITY at Missoula

Established 1893, and consisting of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The Summer Session
The Biological Station
(Flathead Lake)
The Extension Service
The Graduate Department

Frederick C. Scheuch, Acting President

THE STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS at Bozeman

Established February 16, 1893, and consisting of

The College of Agriculture
The College of Engineering
The College of Applied Science
The College of Industrial Arts
The School of Music
The Summer Session
The Secondary Schools
  Home Economics
  Mechanic Arts
  Agriculture
The Agricultural Experiment Station
The Agricultural Extension Service

James M. Hamilton, President

THE STATE SCHOOL OF MINES at Butte

Established February 17, 1893
Charles H. Bowman, President

THE STATE NORMAL COLLEGE at Dillon

Established February 23, 1893, and consisting of

The Two years Elementary Course
The Three years Course
The Four years Course
The Graduate Course

Joseph E. Monroe, President

For publications and detailed information concerning the different schools and colleges address the President of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA
SCHOOL OF MINES SERIES No 1

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ANNOUNCEMENTS
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BUTTE, MONTANA
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SCHOOL CALENDAR 1917-1918

1917

September 4, First Semester begins.

November 9, Close of First Term.

November 12, Second Term, First Semester begins.

December 21, Holiday recess begins.

1918.

January 2, Holiday Recess ends.

January 18, End of First Semester.

January 21, Second Semester begins.

March 29, End of First Term, Second Semester.

April 1, Second Term, Second Semester begins.

June 7, Commencement Day.

September 3, First Semester begins.

EXECUTIVE BOARD.

Charles H. Bowman (Ex-Officio), Chairman.
B. H. Dunshee
Oscar Rohn

ADMINISTRATIVE OFFICERS

Edward C. Elliott, Ph.D	Chancellor, University of Montana
Charles H. Bowman, M. S.	President
Charlotte Russell	Registrar and Librarian

THE FACULTY

Charles H. Bowman, M. S.
President

George W. Craven, B. S.
Professor of Mathematics and Mechanics.

Theodore Simons, E. M., C. E.,
Professor of Mining Engineering.

Charles H. Clapp, Ph.D.,
Professor of Geology and Mineralogy.

Bancroft Gore, A. B.,
Professor of Metallurgy.

Lester J. Hartzell, E. M.
Professor of Chemistry.

Arthur E. Adami, E. M.,
Assistant Professor of Mining Engineering.

M. F. Haley,
Assistant Millman.

Historical Sketch

An Act of Congress approved February 18th, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22nd, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1st, 1916.

LOCATION

The Montana State School of Mines is located in Butte, just inside the city limits on the west. The site on the southern bench of "Big Butte," the extinct volcano from which the city takes its name, was donated by certain public-spirited citizens. It is easily accessible, one of the lines of the street railway company running within a few blocks. The location is most commanding and the view from the grounds overlooks the city, mines, and smelters, as well as the mountains which form the continental divide and which surround the valley on the east and south.

BUTTE

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city by the leading financiers and mining men of this country and Europe have given this locality such publicity that no one now needs to be told of its leading position in the mining world.

The great reduction plants that have heretofore handled the ore that comes from the mines of this city are being enlarged to treat the increased product. The modern devices for reducing the expense of treatment will be developed on a larger scale, and all of this increase in every department of the mining industry goes to render this place the more desirable as a location for a mining school.

In a very important sense all these mining plants of every description are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of this industry and are thoroughly conversant with the details of the work.

EXCURSIONS

To secure a more thorough and practical acquaintance with the subjects taught in the School of Mines, frequent excursions are made to some of the extensive mining and metallurgical plants in the vicinity of the School.

It is believed that the location of the Montana State School of Mines is unrivalled in the opportunities it offers for such excursions. While in most other mining schools a journey of several hundred miles must be made, at heavy expense to the student, if he wishes to investigate the practical application of the methods and processes employed in the mine and smelter, the opportunity is here presented for daily observation of work, the development and product of which have given to Butte the reputation of being the greater mining center in the world.

The excursions are made by the students of the School under the guidance of instructors, at such times in their course as may be most advantageous to them; but, besides these regular occasions, through the kindness of the managers of the various plants, whenever an operation of unusual interest or importance is about to take place, permission is given to the mining classes to witness the same, under the guidance of their instructors.

Short excursions are also made from time to time to regions near by which illustrate the geological features of the Rocky Mountain system.

In addition to these comparatively short excursions, the sophomores spend eight weeks in the field, where they are given fifteen hours per week in learning the use of surveying instruments, and in such exercises as are detailed under special description of courses. The juniors in like manner spend fifteen hours per week for eight weeks in underground surveys, in the mines, under the direction of the professor in charge of mining engineering, and in map drawing to show underground workings. In like manner the seniors spend four weeks making geological surveys in several of the interesting fields of this and adjoining States.

Through the courtesy of the great mining companies, as well as the smaller operators, and individual miners, the students of the School of Mines have every proper opportunity of visiting these mining plants and observing the operations therein conducted. The great practical advantage that thus accrues to the mining student cannot be overestimated.

BUILDINGS

In 1895 a Building Commission was appointed and authorized by the Legislature to issue bonds, the proceeds of which were to be used for the erection of a suitable building for the School. The issue of bonds returned the amount of $120,000.00, and during 1895 and 1897 a four-story pressed brick building was erected. This main building measures one hundred and eighteen feet along the front; the depth is ninety-four feet. There are 37,000 square feet of floor space utilized in class rooms, laboratories, etc. The basement floor is given up to chemical and metallurgical laboratories and to a mechanical testing laboratory. The next two floors contain the recitation rooms, the drafting rooms, the mineralogy laboratory and the library. The fourth floor is given up mainly to museums containing extensive collections of minerals, mine models and exhibits illustrating geology. There is also a petrographic laboratory on this floor where ample table room is supplied together with requisite cabinets of rock specimens, thin sections, etc.; the laboratory contains the machines necessary to cut rock and mineral sections.

The Legislative Assembly of 1907 appropriated $59,000.00 for a new heating plant and an additional building to be equipped as an ore-dressing and metallurgical plant. The second building was completed in 1908, and measures 70 feet by 110 feet. The building is now equipped to handle large quantities of ore conveniently, offering treatment by most of the standard processes now in practice, a detailed account of which may be found under the proper heading. The mill building contains the steam and electric power plant which supplies power to the mill and affords a fine laboratory in this line for instruction and practice for the students.

The gymnasium building is the latest acquisition to the school's equipment, being erected in 1910. It is constructed along the established line of architecture, and measures 87 feet by 50 feet. The building contains one large gymnasium hall 70 feet by 45 feet, at one end of which is a balcony with a seating capacity for 100 people. The hall may also be used as a general auditorium on special occasions. Connected with the gymnasium are two parlors, a dressing room, and in the basement a room equipped with shower baths, toilets, etc.

MAINTENANCE

The maintenance of the Montana State School of Mines is provided for by the State through biennial appropriations made by the Legislative Assembly. The sum provided for the biennium ending February 28, 1919, is $77,000.00.

The aim of the Montana State School of Mines is to furnish the best possible education to those whose life work will be devoted to mining in any of its branches. The School is therefore wholly a technical one, not providing an education for the business man, the farmer, or the literary man, but confining its energies entirely to the proper mental equipment of mining men. The course of study, which is fully described in the following pages, has been elaborated with this purpose constantly in mind.

EXPENSES

Fees.—By the Act establishing the School of Mines, no charge of tuition is to be made where the student is a bona fide resident of Montana. Students from other states or counties will pay a tuition fee of $25.00 per semester, or $50.00 per year.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

Deposits.—To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each student is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is the list of deposits that are required:

FRESHMAN YEAR.

General Chemistry and Qualitative Analysis	$15.00
Plane Surveying	10.00

SOPHOMORE YEAR.

Quantitative Analysis	$15.00
Mineralogy	5.00
Deposit for Platinum Ware	30.00

JUNIOR YEAR.

Mine Surveying	$10.00
Assaying	10.00

SENIOR YEAR.

Metallurgy	$15.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or its vicinity, and at such places as approved by the faculty. The expense for board and lodging is not higher than in other important cities of the West. Good board can be secured at $25.00 per month, while the cost of a good room large enough for two persons and including light and heat will be from $15.00 to $25.00 per month, according to location and the furnishings. Cost of text-books average about $25.00 a year. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as are found here.

In accordance with the provisions of House Bill No. 215, enacted by the Fifteenth Legislative Assembly, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round trip between his Montana home and any institution of the University of Montana once a year, will be refunded.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance to the freshman class. This must include at least fifteen units of work. The term unit means one subject pursued for at least thirty-six weeks with not fewer than five recitations per week of forty-five or more minutes each. Two periods of laboratory, shop or drawing work count the same as one recitation.

Of the fifteen units required, three are required in mathematics, distributed between algebra and plane and solid geometry; three are required in English composition and literature; and one is required in physics.

ADMISSION ON CERTIFICATE

Graduates of the accredited high schools of Montana obtain admission by presenting certificates of principals stating subjects taken, time given for each, and grades obtained.

Blanks for such certificates are furnished by the registrar. These should be filed in the registrar's office on or before the first day of registration.

LIST OF ACCREDITED HIGH SCHOOLS, 1916-1917.

DISTRICT HIGH SCHOOLS: Alberton, *Anaconda, Baker, Belgrade, Belt, *Billings, Bridger, *Butte, Camas Prairie, *Chinook, Columbia Falls, *Columbus, Conrad Corvallis Culbertson, Cutbank, Eureka, *Forsyth, Fromberg, *Glasgow, *Great Falls, *Hamilton, Hardin, Harlowton, *Havre, *Helena, Hysham, Joliet, Laurel, Lavina, Libby, Malta, Moore, Plains, Plentywood, Polson, Pony, Ravalli, Roundup, Ryegate, Shelby, Sheridan, Sidney, Stanford, Stevensville, Terry, Thompson Falls, Three Forks, Valier, Victor, Virginia City, Whitefish, Whitehall, White Sulphur Springs, Worden.

COUNTY HIGH SCHOOLS: *Beaverhead (Dillon); Broadwater (Townsend); *Carbon (Red Lodge); *Choteau (Fort Benton); *Custer (Miles City); *Dawson (Glendive); *Fergus (Lewistown); *Flathead (Kalispell); *Gallatin (Bozeman); *Granite (Philipsburg); Jefferson (Boulder); *Missoula (Missoula); *Park (Livingston); *Powell (Deer Lodge); *Sweet Grass (Big Timber); *Teton (Chouteau); Wibaux (Wibaux).

PRIVATE SCHOOLS: Academy of the College of Montana (Deer Lodge); Academy of Montana Wesleyan University (Helena); Academy of Mount St. Charles College (Helena); Butte Business College (Butte); Central High School (Butte); Loyola High School (Missoula); Mount Angela Ursuline Academy (Great Falls); Polytechnic Institute (Billings); Sacred Heart Academy (Missoula); St. Vincent's Academy (Helena).

Preparatory work done in other schools than those accredited may receive credit. Applicants from such schools should present certificates stating the same points as those given from accredited schools. Blanks for this purpose are furnished by the registrar. When the evidence of certificate is not clear and satisfactory, examinations will be given.

Graduates of high schools not in Montana are admitted on certificates without examination, if such high schools are accredited to their own state universities.

*These schools are accredited by the North Central Association of Colleges and Secondary Schools for the year 1916-1917.

ADMISSION ON EXAMINATION

Applicants wishing to receive entrance credits on subjects for which they do not present satisfactory certificates are required to take examinations on days prescribed in the calendar. For the academic year 1917-1918 these days are September 4 and January 21.

Those who are preparing to take entrance examinations should correspond with the registrar for suggestions in regard to such preparation.

ADMISSION OF SPECIAL STUDENTS

Students 21 years of age or older, not candidates for degrees, may be admitted without the usual entrance units, as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired.

Special students may acquire status as regular students and become candidates for degrees upon complying with the rules applicable to such cases.

ADMISSION TO ADVANCE STANDING

Students entering from collegiate departments of other colleges and universities must bring certificates of honorable dismissal. Upon presentation of the proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

REQUIREMENTS FOR GRADUATION

The School confers the degree of Mining Engineer upon those who have completed the course as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

HIGH SCHOOL HONOR SCHOLARSHIPS

Regulations Governing High School Honor Scholarships for the Year 1917-1918.

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana it is the declared policy of the State Board of Education to provide for the awarding of scholarships to be known as "High School Honor Scholarships" to graduates of the accredited high schools of the State.

In the administration of this policy the number of scholarships awarded each year in any accredited high school will depend upon the number of graduates, as hereinafter specified. In no case, however, will more than two such scholarships be awarded each year in any high school for any one of the institutions of the University. High School Honor Scholarships may be awarded only to students who belong to the highest one-fourth of the graduating class in scholarship.

The following general regulations will govern the awarding of High School Honor Scholarships:

1. Upon presentation of the required certificate from the principal, the Chancellor of the University will authorize the award each year to graduates of each of the accredited public high schools of the State of High School Honor Scholarships for the component institutions of the University of Montana.

2. To be eligible for a High School Honor Scholarship the individual must be certified by the principal:

(a) To be a graduate of a accredited high school of the State.

(b) To belong to the highest one-fourth of his class in scholarship; and

(c) To be a student of ability and of promise of success in college or professional school.

3. No graduate shall receive a High School Honor Scholarship unless he shall have belonged in scholarship rank to the highest one-

fourth of his class. No more than one scholarship may be awarded to the membership of any graduating class having seven or fewer graduates; no more than two scholarships may be awarded to the membership of any graduating class having eight to eleven graduates; no more than three scholarships may be awarded to the membership of any graduating class having twelve to fifteen graduates; no more than four scholarships may be awarded to the membership of any graduating class having sixteen or more graduates.

The High School Honor Scholarship of any year for any one of the University institutions shall be awarded to that eligible graduate standing highest among those desiring to attend that institution.

4. The holders of High School Honor Scholarships shall be exempt from the payment of all customary fees, except the student activity fees and special tuition fees in the schools of Law and Music. All holders of High School Honor Scholarships will be expected to make the required course deposits.

5. Any High School Honor Scholarship will become void unless the holder enters one of the institutions of the University within eighteen months after graduating from the high school. The holder of a High School Honor Scholarship must give notice to the Registrar of the institution of his intention to utilize the scholarship, not later than September 1 of the year in which he intends to enter the institution.

6. Any High School Honor Scholarship will be valid as long as the holder is in attendance upon some regular course leading to graduation; provided, however, that no High School Honor Scholarship shall be valid for a period of longer than five years.

7. In case any individual to whom has been awarded a High School Honor Scholarship relinquishes the scholarship without entering the institution, or for any reason fails to enter the institution in compliance with Section 5 of these regulations, the high school principal may certify the next ranking eligible member of the same graduating class desiring to enter the particular institution.

8. The privileges of a High School Honor Scholarship may be retained only so long as the holder maintains a standard of scholarship and regularity of attendance satisfactory to the faculty of the institution at which he is in attendance.

MILITARY SERVICE SCHOLARSHIPS

Upon the proper certification of the president that a student has been a member of the Second Montana Infantry and rendered service with that regiment on the Mexican border and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service scholarship to such student. The holders of such scholarships, throughout their course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

GENERAL UNIVERSITY STUDENT LOAN FUNDS.

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds which are available for students in the junior and senior classes of any of the institutions of the University of Montana, who are unable to continue their studies without financial aid, and are satisfactorily recommended as to character and scholarship by the dean or director, or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loans must be repaid within one year from the time of borrowing, or in exceptional cases, one year after graduation. Loans bear two per cent interest.

Application blanks and a statement of detailed regulations governing these loans may be obtained from the Registrar.

COURSE OF STUDY

FRESHMAN YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Higher Algebra	3	3
Trigonometry	5	5
Chemistry Lectures	3	3
Chemistry Laboratory	6	6
English	2	2
Descriptive Geometry	2	2
Mechanical Drawing	9	9

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Analytical Geometry	5	5
Plane Surveying, Theory	3	3
Descriptive Geometry	2	2
Chemistry Lectures	3	3
English	2	2
Chemistry Laboratory	9	9
Mechanical Drawing	6	6

Plane Surveying Field Work, Summer Course of Four Weeks.

SOPHOMORE YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Calculus	5	5
Physics	6	6
Chemistry, Lectures	2	2
Chemistry, Laboratory	6	9
Mineralogy, Lectures	3	3
Mineralogy, Laboratory	0	6
Topograprical Drawing	9	0

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Calculus, Anal. Mechanics	5	5
Physics	4	4
Chemistry, Lectures	1	1
Chemistry, Laboratory	9	9
Mine Surveying, Theory	2	2
Mine Surveying, Theory	2	2
Mineralogy, Lectures	3	3
Mineralogy, Laboratory	6	6

JUNIOR YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mechanics	5	5
Mining	2	2
Geology	5	5
Metallurgy, Lectures	3	3
Mine Surveying, Practice	15	0
Engineering Design	0	9
Graphhics	0	6

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mechanics and Hydraulics	5	5
Mining	2	2
Geology, Lectures	5	5
Metallurgy, Lectures	3	3
Engineering, Design	6	3
Geology, Laboratory	3	3
Assaying	6	6
Mining, Laboratory	0	3

SENIOR YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Economic Geology	5	5
Mining	2	3
Ore Dressing	0	2
Metallurgy	3	2
Mechanical Engineering	5	3
Geology, Field Work	3	3
Metallurgicol, Laboratory	15	6
Engineering Design	0	6

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mining	3	3
Ore Dressing	2	2
Metallurgy	3	3
Metallurgy, Laboratory	6	6
Power Transmission	3	3
Engineering Construction	2	2
Engineering Design	6	6
Mining Law	2	0
Mining Geology	5	5

ENGLISH

PROFESSOR C. H. BOWMAN.

Two hours per week during the Freshman year are allotted to the study of English composition. The work is designed to continue the training outlined in the usual high school course, the chief aim being to create an individual and effective means of expression and communication for the ordinary demands of professional life. The ability to express oneself accurately and with some degree of elegance is an advantage which is not easily overestimated. At the same time the stimulating of literary sympathy and appreciation is kept in view, this we deem especially desirable in a professional course, as it supplies an element which is a source of pleasure in after life.

The work begins with a series of classroom lectures and discussions during which time the students are given simple exercises in writing; special attention is given to grammar, punctuation, choice of words, etc. Finally this work is extended to the study of the paragraph and the more complete theme.

During the latter part of the year the class is organized to develop the debate together with the regular theme writing. Proper form and fluency in speaking to an audience is a matter cultivated throughout the year. Among the other helpful features of the course may be mentioned a thorough and practical drill in parliamentary law instruction on note taking, on making outlines, on writing examination papers and on the use of the library. The reading assignments for critical study are drawn mainly from the best technical magazines, from the best editorials, while occasionally a book of purely literary merit is assigned for review.

MATHEMATICS

PROFESSORS CRAVEN AND BOWMAN, ASST. PROFESSOR ADAMI.

Algebra.—A preliminary course is first given designed to drill the student in the fundamental algebraic operations and in the statement and solution of simple mechanical problems. This review is followed for the remainder of the semester by a careful study of those operations of advanced algebra which will be of use to the student in future engineering courses. Special attention is given to the theory and use of exponents and logarithms, simultaneous quadratic equations, the more common series with their practical applications, indeterminate coefficients and quantics solved by synthetic division and by graphical methods. Text, "Higher Algebra," by H. E. Hawkes.

Freshmen first semester, three hours per week

Trigonometry.—In plane trigonometry the subjects of primary importance are: Goniometry; solutions of right and oblique triangles, and practical problems; and in spherical trigonometry the solution of the right and oblique spherical triangles is developed and practical application is made to surveying and mensuration. Text, Wentworth's "Plane and Spherical Trigonometry.

Freshmen, first semester, five hours per week.

Analytical Geometry.—This course from its very nature becomes a thorough review of algebra, geometry, and trigonometry. The material gathered from these three sources is combined in a most striking way, which leads to a practical working knowledge of these branches of mathematics. The student is required to study and plot accurately numerous problems covering such topics as the point and straight line in a plane, different systems of co-ordinates, conic sections, higher plane curves, the point and straight line in space, curved surfaces, and surfaces of revolution. Toward the end of the course the student is required to study various mechanical movements, to devise movements and to determine the laws and equations involved. Text, "Analytical Geometry," by H. B. Philips.

Freshman, second semester, five hours per week.

Calculus.—Among the topics studied in this course may be mentioned differentiations, tangents, normals, subtangents, subnormals, asymptotes, indeterminate forms, logarithms, maximi and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text, Taylor's "Differential and Integral Calculus."

Sophomores, throughout the year, five hours per week.

GEOLOGY AND MINERALOGY

PROFESSOR CLAPP.

Mineralogy.—The purpose of the course in Mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests and by sight is the object sought. The course is presented by means of lectures and recitations, laboratory practice, museum study, and by short field trips for the purpose of collecting minerals and observing their mode of occurrence. The course is subdivided into Crystallography, Blowpipe Analysis, and Determinative and Descriptive Mineralogy.

Crystallography is first studied by means of lectures, recitations and laboratory practice in the identification of natural crystals and models. Its aim is to familiarize the student with the principles of the subject and to enable him to identify crystallographic forms and their combinations. Blowpipe analysis is also preparatory to determinative mineralogy and its aim is to train the student in the use of the blowpipe and in the rapid methods of qualitative analysis suitable for the determination of elements in minerals.

The instruction in descriptive and determinative mineralogy consists of lectures, recitations and laboratory work. At first about seventy-five of the most important minerals are identified and their physical and chemical properties carefully determined and described in the laboratory. This work is supplemented by the lectures and recitations on the character, distinguishing features and occurrences of about two hundred minerals. The final and most important work consists in the rapid identification of about a thousand specimens of one hundred and fifty minerals, as far as possible by sight methods or by methods applicable in the field. Text, Ford-Dana's "Manual of Mineralogy."

Sophomores, first semester, first term, three hours per week.

Sophomores, first semester, second term, nine hours per week.

Sophomores, second semester, nine hours per week.

Geology.—The principles of geology are developed through lectures, field excursions, and laboratory exercises. Physiographic, dynamic, and structural geology are first studied, followed by a brief outline of historical geology and geology of North America. Montana geology is given particular attention. The needs of the mining engineer are kept constantly in mind and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text, Pirsson and Schuchert's "Textbook of Geology."

Juniors, first semester, five hours per week.

Juniors, second semester, eight hours per week.

Economic Geology.—The course in economic geology takes up the more theoretical aspects of the geology of ore deposits, including structural features, the transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment, by means of lectures, recitations, and exercises. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and nonmetallic, especially those of North America, is gained by the preparation of reports and maps. Field trips are made to mines and quarries to supplement the classroom work. Text, Lindgren's "Mineral Deposits."

Seniors, first semester, five hours per week.

Field Geology.—A course in the various methods of geological surveys including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared during a two weeks' field course, but material for laboratory study is collected and geological reports are written.

Seniors, first semester, three hours per week.

Mining Geology.—This course consists of two weeks of field work in the principles and practice of underground geologic mapping. Reports are prepared on the mines examined and lectures are given on the application of geology to mining problems.

Seniors, second semester, five hours per week.

CHEMISTRY

PROFESSOR HARTZELL.

General Chemistry.—The subject of General Chemistry is presented in lectures and text books.

The object of the course is to develop the underlying principals of the subject as a basis for all subsequent work in the department. The student is made familiar with the principal characteristics and relations of the elements one to another, the work being illustrated by experiments conducted by the instructor. In this work the student is directed to read from text-book references, and it is essential for those who take the course to take notes on the lectures which are designed to aid and direct the work performed in laboratory practice during the semester. The text book used is "General Chemistry for Colleges," by Alexander Smith.

Freshmen, throughout the year, three hours per week.

General Chemistry, Laboratory.—The course of laboratory study in this subject consists of performing a number of experiments by the students at individual desks. This course is designed to teach the student the use of the various kinds of apparatus, chemical agents and reagents, besides becoming familiar with their reactions and relations with each other. A neatly kept note book is essential in this work, in which is kept a record of the statement, reactions and principles involved in each experiment.

Freshmen, first semester, six hours per week
Freshmen, second semester, nine hours per week.

Qualitative Analysis.—This course is designed to instruct the student in the general scheme of analysis by which the different metallic elements are detected and separated from each other. The more common acid radicals, their identification and isolation also forms a part of the course.

Lectures accompany the work giving a general outline of the schemes, separations, etc., dealing with the merits and difficulties of each, finally pointing out the most satisfactory proof in each case. The essential element of writing and balancing equations is a part of the drill work in class-room exercise. Chemical Arithmetic or Stoichiometry is also taught during the latter part of the second semester.

The text book used is "Qualitative Analysis," by Prescott and Johnson.

Freshmen, second semester, three hours per week.

Quantitative Analysis.—This course is designed to meet the needs of the mining engineer in the pursuit of his profession. It embraces all the general analyses, such as analysis of limestone, dolomites, rock analysis, ores of iron, manganese, lead, zinc, arsenic, copper and many others such as the analysis of artificial substances, among which are given, mattes, slags, flue dust, concentrates, roasted ore (calcines) and pig iron and steel.

The subject of acidimetry and alkalimetry is taken up and explained. Analyses are made of different substances to demonstrate this subject.

The work in chemistry throughout is conducted with a view of developing rapid and accurate work on the part of the student. The problems and laboratory work are selected as far as possible from the work of the practitioner in the mining districts, especially of the West. While these practical features are employed the instructor bears it ever in mind that through all the work the student must be required to use his own talents and learn to think and reason for himself.

Sophomores, first semester, first term, two hours lecture per week and six hours laboratory.

Sophomores, first semester, second term, one hour lecture per week and nine hours laboratory.

Sophomores, second semester, one hour lecture per week and nine hours laboratory.

METALLURGY

PROFESSOR GORE, MR. HALEY.

Introduction to Metallurgy.—The study of Metallurgy begins with lectures and recitations on the fundamental principles of the science. The student is familiarized with the names and properties of the commoner metallurgical products. The principles of ore treatment by mechanical and smelting methods are discussed in a general way, leaving the more detailed study of the various processes till later in the course. The principles of combustion, amount of air required, heat carried away by gases, products of combustion, etc., are studied. The various fuel, solid, liquid and gaseous, natural and prepared, and the best way of applying them to attain the desired temperatures are considered. Following this, gas producers and various types of furnaces, i. e., blast, reverberatory, muffled and electric, used in metallurgical operations are described. In connection with this, the methods for utilizing waste heat are discussed. The source and properties of the various refractory materials and their manufacture into bricks and crucibles and methods of testing are investigated.

Juniors, first semester, first term, three hours per week.

Metallurgy of Copper.—The study of the metallurgy of copper is conducted by lectures and recitations covering the subject fully. The electrolytic refining of copper bullion is studied as a part of this course. Immediately after the subject is treated in the lecture and recitation rooms, one week is devoted to a practical study of the smelter and electrolytic refinery at Anaconda or at Great Falls. Each operation in the treatment of copper ores is studied in detail, among them may be mentioned the processes of concentration, the production of matte by both reverbertory and blast furnace; the blowing of matte to metallic copper in the converter and the process of refining copper in the reverberatory refining furnace. Most of the standard methods of concentration, roasting and reduction of copper ores are studied during these visits. A typewritten report of the operations observed is required of each student. The text book used is Peter's "Practice of Copper Smelting."

Juniors, first semester, second term, three hours per week.

Metallurgy of Gold and Silver.—The second semester of the junior year is devoted to the metallurgy of gold and silver. The methods of obtaining gold by dredging and sluicing are treated briefly. The larger portion of the time is taken up with a rather detailed study of the cyanide process from both a chemical and economic standpoint. The various methods of crushing, classifying and treatment of sands and the slime are treated quite fully. The modern devices for handling the sands and filtering the slimes are studied. The other metallurgical processes for silver, such as the Washoe process and the hyposulphite lixiation process, are discussed briefly. The course is completed by a two weeks' excursion to visit the various cyanide and other plants, where a careful study is made of the process and a detailed typewritten report is made by each student. The subjects are presented through lectures and assigned reading.

Juniors, second semester, three hours per week.

Metallurgy of Lead and Silver.—The subject of the metallurgy of lead is studied during the first semester of the senior year and is presented through lectures and assigned reading. The work first covers a historical sketch of the various processes, and finally covers a detailed study of all the reactions, devices and processes found in the modern lead smelting plant. The processes of roasting, the blast furnace practice and the refining of bullion are given full consideration. The class is also given some experience in making all necessary calculations.

Following the course the class is taken to a lead smelter and required to make a detailed study of all departments, submitting a written report of the examinations made at the works.

Seniors, first semester, first term, three hours per week.

Seniors, first semester, second term, two hours per week.

Iron and Other Metals.—The metallurgy of iron and steel is presented through lectures and text-book study. Stoughton's metallurgy of Iron and Steel being the text in present use. Special attention is given to the value of the various ores and the metals and other elements used in the manufacture of alloy metals. In addition to the methods of manufacture of iron and steel into the standard forms of commerce considerable attention is paid to the testing of these products and their uses.

The metallurgy of zinc is covered by a series of lectures where the processes of roasting and retort smelting are fully explained. Attention is also given to the manufacture of the retorts and other devices used about the works.

This course also includes a study of the uses of zinc, together with the uses and manufacture of its alloys.

The latter part of the senior year is taken up with a series of lectures and student reports covering the metallurgy of other metals of commercial importance; among them may be mentioned the metallurgy of tin, nickel, cadnium, aluminum, etc. The careful and thorough study of the preceding metals forms a basis of knowledge about furnaces, metallurgical reactions, etc., which permits an easy understanding of the special features involved in each of the subjects taken up in this course.

The students' part of the work is accomplished through reference to standard works and special articles found in the publications in the library.

Seniors, second semester, two hours per week.

Fire Assaying.—The course in fire assaying is essentially a laboratory drill course. It comes during the Junior and Senior years when the students are familiar with the reagents and most of the chemical reactions used in the work. However, the laboratory work is preceded by a short course in lectures in which the general principles of the art are developed and all equipment carefully explained. Attention is given to the proper care of the furnace and method of controlling the temperature. The special balances used in this work are demonstrated, showing methods of operating, care and adjustments. Finally the class is given a series of notes which embody a description of the charges in actual use in the mining and smelting plants of the West.

In the laboratory work each student is given a desk with a full equipment of reagents and apparatus. Ample furnace room, balances and ore-grinding apparatus are provided so no delays are encountered through lack of equipment. Then each student works through his individual list of ores to be assayed. There are silicious oxidized ores, basic oxidized ores, ores of lead, copper and zinc, all containing various impurities. These are assayed for gold and silver and when lead is present it is also determined. The smelter products likewise receive attention; lead and copper mattes, speiss, antimonial lead, lead and copper bullion, lead and copper slag are all treated according to the custom about the laboratory of the smelter.

Both crucible and scorification methods are used where considered practicable, while the combined wet and dry methods are used upon material such as copper bullion, mattes high in copper, blister copper, etc.

The laboratory work covers about twenty weeks of two afternoons each week. Throughout the course speed and accuracy are considered essential points. Before a student is considered proficient he must be able to accomplish what may be considered a reasonable day's work in a commercial laboratory. Accuracy is required, but it is not sufficient; speed is considered equally important.

In this course no charge is made for materials or equipment except where there is an unnecessary breakage or consumption of material.

Juniors, second semester, two afternoons per week.

Metallurgical Laboratory Practice.—The work of the first term of the Senior year includes the systematic investigation of a large variety of commercial ores for the purpose of determining in each case the most economical metallurgical process for the recovery of the precious or base metals. In connection with this work the students have access to special laboratory equipment of the most approved type for ore testing on a miniature scale. Recent additions to this laboratory include a slide-testing machine for the study on a reduced scale of the oil-flotation process; a large porcelain pebble mill for all-sliming operations, grinding in solution and chlorination work; special air agitation apparatus for the cyanide treatment of refractory ores and concentrates; individual vacuum filters, and a small Kelly filter press for the study of problems involving slime filtration and washing.

A small lot of uncrushed ore, generally not less than fifty pounds, is given to each student, who first makes a careful physical examination indicating the minerals containing the precious or base metals, those composing the gangue, nature of the ore and such characteristics as might have a bearing on the particular line of investigation to be followed. An accurate sample is then prepared, assayed and analyzed for the usual constituents determined in metallurgical practice. A scheme of treatment is then outlined and the results obtained are systematically tabulated, forming the basis of an individual report on the economical treatment of the ore in question.

Experience gained in previous years' work in mineralogy, assaying and metallurgical analysis is made frequent use of in this course, and accordingly no student will be admitted unless qualified in these subjects.

Special emphasis will be given to processes of current interest open to important future developments such as the recovery of values from refractory gold and silver ores and concentrates, oil flotation methods and hydrometallurgical treatment of copper ores. There is practice work in amalgamation, concentration, chloridizing roasting, hyposulphite leaching, magnetic separation and dry chlorination.

Seniors, first semester, first term, five afternoons per week.

Metallurgical Mill Practice.—Data obtained in the metallurgical laboratory during the first semester forms the basis of actual mill tests during the balance of the school year, the aim being to duplicate on a commercial scale the results previously obtained from laboratory samples.

For this work there are crushers, rolls, mills, etc., so arranged as to reduce the handling of the ore to a minimum.

A battery of three stamps offers practice in stamp milling during which tests the class is given practice in dressing the plates and recovering bullion. Other tests involve the use of amalgamating pans, cynaide vats of three tons capacity, a slime and agitation equipment, a lead lined agitation barrel for chlorination work. There are also roasting furnaces with which any of the roasting operations may be carried out that are required in the standard processes of ore treatment.

During this work much attention is given to the handling and adjusting of machinery. Under proper instruction the students operate the mill from the power plant to the tailings dump. This experience is a valuable asset to any young engineer undertaking work, especially with the smaller plants of the west, since mining engineers, even if they are not metallurgists, are frequently called on to operate ore dressing or milling plants. The course also gives excellent opportunity for gaining experience in methods of sampling.

One hour each week is devoted to a discussion of the principles involved in each of the milling operations and individual reports are read and commented upon.

Seniors, first semester, second term, two afternoons per week.

Seniors, second semester, two afternoons per week, conferences one hour per week.

MECHANICS

PROFESSORS CRAVEN AND BOWMAN.

Physics.—Throughout the course in physics the student's attention is directed to a systematic development of the principles of the science. Lectures are aided by demonstrations in which phenomena are shown and later laboratory work is given. While the general subject of physics is covered, it is the aim to develop most thoroughly such parts as add directly to the working knowledge of the mining engineer.

During the first semester the student acquires an analytical knowledge of the mechanics of solids and fluids. Principles and fundamental methods are considered of great importance in this elementary course. Among the topics considered may be mentioned: Concurrent and parrallel forces; center of gravity; resistance and work; simple machines; gravity and motion; inertia and rotation. Numerous problems are solved during this course. In the mechanics of fluids the fundamental principles are developed by lecture demonstrations. During the latter part of the semester the subject of heat is introduced; aside from the nature and measurement of heat, its application to the steam engine and to the transmission of energy by means of compressed air is considered. Text, Jameson's "Elements of Practical Mechanics."

Sophomores, first semester, six hours per week.

Physics.—The second course in physics includes a thorough study of the elements of electricity and magnetism and a brief study of light and sound. The principles and application of electricity to dynamos, motors, the transmission of energy, lighting, etc., are the most essential parts of the course. The work in light includes a study of optical instruments and of the phenomena met in the study of mineralogy and petrography.

During the last term of the semester the class work of the year is supplemented by practice, four hours per week, in the laboratory. Constants in the domain of mechanics and heat are determined and a familiarity is acquired with simple electrical measurements, the running and behavior of dynamos and motors, etc. Text: Jackson's "Elementary Elctricity and Magnetism."

Sophomores, second semester, four hours per week.

Applied Mechanics.—This course is a sequence to the analytical mechanics, which is made a part of the integral calculus. The laws of elasticity and resistance of materials are studied and applied to the proportioning of pipes, cylinders and riveted joints. The general theory of beams including cantilever, continuous and restrained, is given and the graphical solutions are developed as well as the analytical solutions. The application to columns or struts is developed and to shafting for transmitting power. Special subjects are taken up which are of interest to the engineer, such as resilience and work, impact and fatigue, true and internal stresses. Many problems are solved selected from engineering practice to illustrate the theory developed. The course also includes a study of the properties and uses of various building materials, the metals, timber, stone, brick, cement, etc.

It is the object of this course to direct the student's attention to the elements of the design of mining machinery. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keyt, pipes and pipe fittings, shafting, couplings and supports for shafts. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, rope, gearing, etc. special attention is given to the installation and maintenance of machinery, and in this connection a great deal of practical information is obtained by frequent visits about the repair shops of the mines of Butte. Text: Merriman's "Mechanics of Materials."

Juniors, first semester, five hours per week.

Juniors, second semester, two hours per week.

Hydraulics.—A knowledge of this subject is of importance to the mining engineer, especially to one whose field of labor is in the West. The course is introduced with a brief review of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involved in the study of the flow of water through orifices, over weirs, through pipes, flumes and conduits. Attention is given to the elements of design of dams and adjuncts. The immense use of water power for lighting, mining and transportation purposes prompts an investigation of the various turbine, impulse wheels and governing devices. Text: Merriman's "Treatise on Hydraulics."

Juniors, second semester, three hours per week.

Mechanical Engineering of Power Plants.—The discussion of the power plant is preceded by a course of lectures and recitations on Thermodynamics. Attention is paid to definitions and units in the domain of heat, work and power. The laws of thermodynamics are thoroughly developed and numerous related problems are solved. Following this course a systematic study is made of the mechanism of engines, non-condensing, condensing, simple and continuous expansion, valves and valve gearing with their various governing attachments, foundations, bed plates, etc. Steam boiler types are studied together with their setting and management. The designing and construction of chimneys and the general plans for power houses are also made a part of this course. Text: "Steam Engines and Boilers," by J. H. Kinealy.

During this course a series of lectures is offered, essentially descriptive of pumps and pump details, special attention being given to the construction and management of mining pumps. The course is based on "Pumping Machinery" by William M. Barr.

Seniors, first semester, second term, three hours per week.

Seniors, first semester, first term, five hours per week.

Power Transmission.—The extensive use of electrical power together with the abundant water supply for power purposes. The elementary principles are laid down during the sophomore year. In the senior year the student's attention is directed to the general conditions of power transmission, power transmission by electrical energy, synchronous and induction motors, current reorganizers, hydraulic development, the organization of a power station, line construction, centers of distribution, the commercial problems and measurements of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this line of engineering. Text: "Power Transmission," by Bell.

Seniors, second semester, three hours per week.

Graphics.—The work in Graphics follows the Junior course in mechanics. The course is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind, snow, etc. Analysis is made of single-span trusses of various types with horizontal chords, trusses with inclined chord, and continuous trusses. In these problems concentrated and uniform loads are considered, stresses due to a locomotive, also stresses due to the wind, etc. The work is carried on in the drawing room, supplemented by lectures and recitations. "Steel Mill Buildings," by Ketchum, is used as a basis. Twelve practical problems are presented and solved in the drawing room.

Juniors, first semester, second term, six hours per week.

Engineering Construction.—This course consists of lectures and recitations on modern practice in engineering construction. Among the subjects covered may be mentioned: Details of mill building, both frame and steel; construction of retaining walls, foundations, dams, etc., cement, reinforced concrete. The lectures deal with the many practical points in construction and in the handling and care of material. Text, Ketchum's "Steel Mill Buildings."

Seniors, second semester, two hours per week.

MECHANICAL DRAWING AND MACHINE DESIGN

PROFESSOR CRAVEN, ASSISTANT PROFESSOR ADAMI.

Mechanical Drawing.—The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. The beginner in this subject should supply himself with first-class instruments; a good set will serve him for years after his course in school is completed, while an inferior set will cause annoyance and loss of time almost from the beginning. The student should consult the instructor in charge in regard to the kind and number of instruments necessary.

Throughout this course the student applies himself in the drawing room, becoming familiar with the use of drawing instruments and the elements of projections and sections. He is required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to him. While the instructor is always present to assist and see that no time is lost in useless endeavor, it is the aim to guard against the copying of drawings; the student must learn to think and construct for himself. A short time of each period is given to the rapid drawing of problems previously assigned in descriptive geometry. The course also includes practice in free-hand lettering. "Mechanical Drawing," by Faunce and "Descriptive Geometry," by Faunce, are the text books used.

Freshmen, first semester, nine hours per week.

Mechanical Drawing.—The second course in mechanical drawing continues the subject laid down in the first course. The study of descriptive geometry is completed and applied to more difficult problems. During this course the student is taught the use of water colors as applied to engineering drawings, practice is given in coloring maps and shading parts of machine drawings. As far as possible the problems in drawings are taken from those met by the mining engineer in practice; when the student completes his course he is equipped with drawings of the standard timber sets used in mines, with drawings of shaft timbers, head frames and machine drills with the conventions used in mine and geological maps, and many other useful items used in mining.

Freshmen, second semester, six hours per week.

Descriptive Geometry.—Two hours per week throughout the Freshman year are occupied with recitations in descriptive geometry. Throughout the course the students study assigned lessons from a text book, together with the notation work, etc. The class period is taken up for the most part with the working of new problems, especially those involving the point, line, and plane; it is a drill hour in rapidity and accuracy in the application of the essential features of the subject. The procedure insures a thorough mastery of all the elements, an acquisition which is of great value in much of the work of the mining engineer. It assists him in his mechanical drawing and designing, it is indispensible in many problems in mine surveying and aids greatly in part of the work in geology, especially in the practical work in mines where faults and veins are traced and platted.

In the latter part of the work where the more complicated intersections of solids and the developments of surfaces are required, the class works in the drawing room. Here the problems are likewise varied so that the possibility of merely copying or committing to memory is eliminated. The course follows in close touch with the regular mechanical drawing where the more elaborate drawings are completed, dimensioned and inked. Text, Faunce's "Descriptive Geometry."

Freshmen year, two hours per week.

SURVEYING AND TOPOGRAPHICAL DRAWING

PROFESSOR SIMONS, ASSISTANT PROFESSOR ADAMI.

Plane Surveying.—Lectures and recitations, including description of surveying instruments, their construction, adjustment, use and care. Form of field notes for different methods of surveying, computation of bearings, co-ordinates, elevations, areas, quantities of material, from data secured in the field. Solution of problems in surveying requires a thorough knowledge of algebra, geometry and trigonometry. Practical use of surveying instruments on the school grounds. Algebra, trigonometry and the use of logarithms are prerequisites.

Freshmen, second semester, three hours per week.

Mine Surveying.—A course of lectures on underground surveying and shaft plumbing. The course also includes the solution of numerous surveying problems, requiring a thorough knowledge of mathematics. Exercises in platting and in preparing cross and longitudinal sections of underground workings; calculating quantities of material removed from the stopes, and of tonnage of blocked out ore bodies.

Sophomore, second semester, two hours per week.

Plane Surveying, Field Work.—A course of practical surveying in the field. During their stay in the field the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets, etc. Determination of true meridian by solar observation and by observation on Polaris. Traverse survey with transit and steel tape, angles by repetition, azimuth and deflection. Problems in public land surveying in accordance with Manual of Instruction to United States Deputy Surveyors. Official survey of mining claims in application for United States patent; returns to consist of letter of transmittal, plat, field notes and computations, in form of transmission to United States Surveyor General. Topographic survey with transit and steel tape. Stadia and trigonometric survey. Base line and triangulation. Leveling for profile for contour lines and for establishment of bench marks. Staking out buildings and excavations for foundations and calculation of quantities to be excavated. Survey of ditch or flume line. Preliminary and location survey of railroad.

Freshmen Summer Course, four weeks.

Mine Surveying, Field Work.—A course of practical mine surveying at a mine in actual operation. During their stay at the mine the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets, etc.; establishment of a base line and determination of its true bearing by solar and polaris observation. Complete survey of the surface arrangement of a mine, showing all buildings and structures, shafts, adits, etc., with their relative elevations. Complete survey of the underground workings of a mine; including shafts, levels, raises, winzes and stopes. Plumbing a vertical shaft by various methods. Calculating latitudes and departures of underground surveys and preparing a survey record, showing station numbers, horizontal and vertical angles, slope and horizontal distances, true bearing, latitude and departure of all courses; the co-ordinates for each station north, south, east and west of an assumed initial point; also the elevation of each station above an assumed datum, calculated from the vertical angles and slope distances. Checking surveys by platting and calculation, and adjusting allowable errors by approved methods.

Juniors, first semester, first term, fifteen hours per week.

Topographical Drawing.—The work consists in platting on a convenient scale the surveys executed in the field by the Sophomores. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps, mills, etc. The students also receive directions in the construction of contour lines and in laying out railroads and wagon roads, dams, reservoirs, flumes, ditches, etc., on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, etc., by cross sections made from such contour maps. In this work special attention is given to lettering, titles, borders and north points, and general neatness in execution.

Sophomores, first semester, first term, nine hours per week.

MINING, ORE DRESSING AND ENGINEERING DESIGN

PROFESSOR SIMONS, ASSISTANT PROFESSOR ADAMI.

Mining.—An outline of the geographical and geological distribution of the ores of the useful minerals. Prospecting, discovery, locating and acquiring title to mining claims. Breaking ground by the various methods of hand work, rotary and percussion drills. Explosives and their uses. Supporting excavations by timbering, masonry and metallic supports. The lectures and recitations are illustrated by drawings, prints, models and frequent visits to the local mines where mining operations are observed.

Juniors, first and second semester, two hours per week.

Mining Laboratory Practice.—One afternoon a week is spent in studying air drills, besides making actual tests on various kinds of drills, such as air consumption, rate of drilling, efficiency tests and cost of operating. In addition to the above the students take trips underground to make a study of the practical side of mining. Special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drilling and boring by percussion drills.

Juniors, second semester, second term, one afternoon per week.

Mining.—Exploitation of the useful minerals by open work, and the various methods of underground stoping. Mine haulage. Hoisting and hoisting machinery and accessories. Drainage and pumping. Air compression. Ventilation, natural and artificial. Lighting and sanitary arrangements. The study of mining operations on a commercial scale. The superintendence and management of mines. Selecting and buying supplies and machinery for mining operations. Mining economics and mine accounts. Examination and reporting on mines and mining enterprises.

Seniors, first semester, first term, two hours per week.
Seniors, first semester, second term, three hours per week.

Mining—Prospecting for placer deposits. Exploitation of gold placers by various methods, including hydraulicking and dredging. Water supply for hydraulic and other mining operations. Reservoirs, dams, ditches and pipe lines.

Seniors, second semester, three hours per week.

Ore Dressing.—Lectures and recitations. The object and general principles of ore dressing. Stamp milling, followed by amalgamation and concentration. Description of the construction and operation of the principle types of crushers, stamps, classifiers, concentrating tables and accessories. The lectures are amplified by frequent visits to local mills and ore dressing plants and by practical tests in the school laboratory.

Seniors, first semester, second term, two hours per week.

Ore Dressing.—A study of the physical laws governing the various processes of ore dressing, the laws of crushing, of jigging, of free and hindered settling. The principles of screen sizing and hydraulic classification. Study of the construction and operation of typical milling machinery, rolls, grinding mills, jigs, tables, vanners, magnetic separators, flotation processes and mill accessories. Power transmission and water supply for milling operations. The study of design and methods of ore dressing at plants visited during the school year Practical tests in the ore dressing department of the school laboratory.

The course of Mining and Ore Dressing is completed by a two weeks' excursion to districts where Mining and Ore Dressing methods can be studied which do not prevail in the Butte district.

Seniors, second semester, two hours per week.

Mining Engineering Design.—In this work the students are taught to make designs of structures in woods, masonry, and metal, such as are required of the mining engineer These designs include ore and coal bins, railroad trestles, head frames, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems with all conditions and requirements are dictated to the students in the classrooms. Numerous blueprints obtained from actual structures are on file for reference.

Juniors, first semester, second term, nine hours per week.

Junior, second semester, six hours per week.

Mining Engineering Design.—Leading up from the design of single structures this course consists in the design of a complete plant for one or more of the operations of mining and ore dressing. Besides the design and arrangement of a plant for the exploitation of the mine, each student also makes a design of a complete concentrating and stamp mill. It is the aim in this course to develop the originality of the student; although the professor in charge is always present to assist, the student is thrown upon his own resources as far as possible. He is required to make use of catalogue and reference books to obtain the data necessary for the completion of his problem. Attention is given to assembling, bills of materials, and the item of costs. The problems are given to the students and discussed in the classroom.

Seniors, first semester, second term, and second semester, six hours per week.

MINING LAW

JUDGE EDWARD B. HOWELL OF THE MONTANA BAR.

A course of instruction on the law relating to mining claims, including the method of acquiring title from the United States to lode, placer, tunnel and mill-site claims in the various states and Alaska, with a comparative study of federal and state laws on the subject, the law relating to extralateral rights, leases, options to purchase, conveyance of mining claims, and water rights, the relative rights of citizens and aliens in the tenure of mining claims. The object of the course is to give the student a good working knowledge of mining law, and to this end students are required to draft location notices and similar instruments that might become necessary in their work in the field. Through the recitations the class is given a thorough drill in rights of the locator, also in ways in which these rights may be transmitted or may be forfeited, all principles being abundantly illustrated by actual and hypothetical cases. Questions of more complexity are illustrated by elaborate models and charts, many of these models were constructed to represent the claims of mining companies in the courts.

The course in Mining Law consists of lectures and recitations covering a period of two months and is required of the Senior class. The class uses as a text book for this course Mr. Howell's manual on "Lode and Placer Claims."

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of the State. The total sum invested for this purpose now amounts to nearly $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School. The descriptions which follow concern the more important articles that have been procured to illustrate or to facilitate the work in the several departments.

DEPARTMENT OF MATHEMATICS.

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor, abundantly supplied with blackboard space, terrestrial and celestial globes, some simple models, and a blackboard ruled in squares for tracing the graphs of equations and of natural phenomena.

DEPARTMENT OF CHEMISTRY.

In this, as in all other departments where laboratory work is required, the demand for a large and varied equipment of apparatus and facilities for investigation is great, and the successful prosecution of the purpose for which the technical school is maintained is directly related to the perfection of this equipment. Nearly three-fourths of the entire first floor or basement of the School of Mines has been devoted to the use of this department, together with a lecture room on the second floor. In this space four laboratories have been fitted up, one for qualitative and quantitative analysis, one for metallurgy, and two special laboratories. To these have been added a balance room, a store room for laboratory supplies and a dispensary where the prepared tests for the students in the laboratories are kept.

The laboratories are furnished with working desks of the most approved pattern—each student having his own particular stand—where he is supplied with gas, water, blast, Bunsen burners, a rack for chemical reagents and a cupboard with lock and key so that he can keep securely the apparatus and material assigned for his use. The laboratories are also supplied with hoods in which are to be found hot plates, air baths, steam evaporating pans, hydrogen-sulphide apparatus and a flue with a strong draft to draw off the noxious vapors. The laboratories for qualitative and quantitative analysis and for metallurgy are sufficient for the accommodation of 48 students each.

The students' balance room is provided with six analytical balances for the use of the student in the laboratories. These balances are placed on piers disconnected from the walls and floors of the building so that the vibration is reduced to a minimum.

The special laboratories and preparation rooms are equipped with modern conveniences for carrying on analytical and metallurgical work. In these rooms all the chemical reagents are prepared for the use of the student in the laboratories and all check analysis on the students' work is made. Two dark rooms are provided for photographic work, spectrum analysis, making blue prints and lantern slides.

The chemical lecture room, located on the second floor, is provided with a demonstrating table, furnished with pneumatic trough, gas, water, hydrogen and oxygen blast and direct and alternating currents of electricity up to 750 volts and 45 amperes. The demonstrating table is backed with a hood furnished with the same appurtenances as are provided for the hoods in the laboratories.

DEPARTMENT OF METALLURGY.

The assay laboratory is situated on the first or basement floor of the building, and is equipped with six of the latest model coal assay furnaces. There are also two gas assay furnaces and one gasoline furnace, which can be used for special work, and a gas retort and melting furnace for melting bullion, making alloys, retorting amalgam, casting copper and other anodes, etc.

The pulp room adjoins the assay laboratory, where all charges are weighed and fluxed. Convenient cupboards are provided for storing samples. The silver and gold balances are located in the same room as the analytical balances, and are of the latest approved design.

The crusher room is provided with a Gates crusher, a Low crusher, an Englebach grinder, capable of grinding pulp to 80 mesh, a Braun planetary pulverizer, a buckingboard, tables upon which to roll samples, and a series of drawers capable of holding 454 twenty-five-pound pulp samples. The supply of assay samples consists of a large number of copper, lead, gold and silver ores, together with mattes, both copper and lead, slag, flue-dust, calcines, concentrates, tailings, and all smelter products from the copper and lead smelters and other plants of the state.

In the assay laboratory are located separate cyanide outfits for testing ore by the cyanide process. There is also located in this laboratory, a calcining furnace capable of being used as a reverberatory or muffle roasting furnace, where large lots can be calcined, or a chlorination roast can be made for hyposulphite treatment.

There are arrangements for treating free milling gold ores by the amalgamation process, as well as cyaniding the tailings from this process.

Gas analysis is at present carried on in the chemical lecture room. There is a very complete set of Hempel's gas apparatus, and analyses are made of gases of combustion, reverbatory and blast furnace, illuminating gases, etc.

A dark room for students' use adjoins the balance room, which contains a large Kirchoff-Bunsen spectroscope and supplementary apparatus for qualitative analytical work in determining the presence of the alkali and alkaline earth metals by their volatilization in the non-luminous flame of the Bunsen burner. The spectroscope is provided with a scale for the determination of the exact location and relative position of the lines of the spectra, or, two spectra may be studied and compared at the same time.

MINING, ORE DRESSING, AND METALLURGY.

A room 24 by 31 feet is provided on the second floor for lectures in the various branches of mining and ore-dressing. The drawing classes occupy three large, well-lighted rooms. Ample table-room and individual drawer room are provided throughout; cabinets for filing drawings and drawing-boards are also provided. A large collection of drawings furnished by various manufacturing companies of mining machinery is on hand and is used as an aid to the student in developing new work. The collection of parts of machines is gradually increasing. This material is of great assistance to the department in developing the work in machine design.

For the practical work in surveying the following instruments have been provided: Ten engineering transits; one from Buff and Buff, two from C. L. Berger & Sons, four from Gurley, one from Keuffel and Esser, one from Young and Son, and one from Eugene Dietzgen. Five levels—one from Buff, one from Gurley, two from Keuffel & Esser, one from Berger, and one from Young & Son. One solar compass and one sextant with artificial horizon, from Gurley; two aneroids by Short & Mason (London), and a collection of minor apparatus, including Brunton compass, clinometers, Locke levels, chains, tapes, plumets, shaft plumbing equipment, rods and flags, necessary in carrying on the work of the department. To this equipment has recently been added by donation a plane table with alidade, a Breithaupt and Sons' level with tripod, and a Tacher's calculating instrument.

A mine model has been constructed in the school shops for use in the lecture room, which greatly facilitates the solving of many of the more complicated problems in mine surveying.

The metallurgical laboratory occupies a building by itself. This building also contains the central heating plant and the engine and dynamo room. The metallurgical laboratory proper occupies a room 77 by 70 feet, half of which is devoted to ore dressing. The ore dressing department consists of a set of storage bins with a capacity of from 80 to 100 tons of ore. One eight-inch by twelve-inch Dodge crusher, two sets of twelve and one-half-inch by twelve-inch rolls, two belt elevators, three trommels thirty inches in diameter and forty-eight inches long, one impact screen for dry screening, a duplex Callow screen for screening to forty and eighty mesh, three Evans and one Hartz jig, one Huntington mill, one Wilfley table, one four-foot Frue Vanner and a dings magnetic separator. There is also a three-stamp mill with amalgamating table. Accessories consists of classifiers, settling tanks, centrifugal sand and water pumps, etc.

An equipment for making cyaniding tests provides for leaching ores in five-ton lots. In this plant sands and slimes may be separated, dewatered and treated separately. There are five vats and two sump tanks, one steel tank provided with air and mechanical agitators. All necessary filters, zinc boxes, etc., for making commercial tests are installed for use in this plant.

A pan amalgamation plant consists of a Bruckner chloridizing furnace, a pan amalgamator and settling tank. All the usual equipment, such as steam, launders and utensils, etc., are at hand for the convenient working of this plant.

The laboratory contains a Wedge furnace designed to be used as a reverbatory or a muffler furnace. This furnace is mechanically rabbled and used in roasting ores in lots of one ton or more. There is also a lead-lined agitation barrel provided for experiments involving this type of apparatus.

The mill is arranged in such a manner that complete tests on a commercial scale can be made on various kinds of ore by shifting the travel of the ore over such machines as are found to be best suited to treat any particular ore.

The laboratory also contains a miniature testing plant consisting of small sized jigs. Wilfley table, hydraulic classifiers, automatic feeder, etc., for testing ore in quantities up to four pounds, preliminary to sending the ore through the large mill.

The museum of the school contains a very complete collection of the products from the ore dressing plants at the Butte, Anaconda and Great Falls smelters. These samples are extensively used in lectures on ore dressing, as they show in a most excellent manner the mechanical changes which a particle of ore undergoes during its travel through the various machines, designed to separate the valuable metal from its gangue.

On the tables of the library may be found all the leading American technical magazines as well as many foreign publications. The library also contains a valuable collection of text books on all the subjects of civil and mining engineering, the use of which is open to all students upon application to the librarian. The office of the Professor of Mining and Ore Dressing also contains a large collection of catalogues, blue prints, and bulletins from leading manufacturers of mining, milling and smelting machinery. The school is indebted to these manufacturers for the supply of such catalogues and for the many extra copies which they have kindly furnished for distribution among the students.

Several mine maps, an ideal section of a Butte copper vein, a very attractive section through part of the Boston & Montana concentrator at Great Falls, and a great number of appropriate photographs and drawings decorate the walls of the museum and library; these include views of Montana mining towns, the Washoe smelter at Anaconda, of the Boston & Montana smelter at Great Falls and of various mines and mills about the State. There is a large drawing to illustrate the method of sampling in use at the Taylor & Brunton Sampling Works (now the Washoe Sampling Works) at Butte, and also several drawings of coal washery of the Cottonwood Coal Company. Finally there are several diagrams, illustrating the relative production of copper, silver and gold in Montana and other states.

The various mine models, donated from time to time by leading mining companies of Butte, are exceedingly useful in demonstrating not only the geological features indicated on such models, but also the various phases and methods of shaft sinking, drifting, cross-cutting and stoping, practiced in the mines represented by said models.

DEPARTMENT OF GEOLOGY AND MINERALOGY.

The department of geology and mineralogy occupies five rooms and part of four others. On the second floor are the office, the lecture room, and the mineralogical laboratory, with provision in the library for certain maps; and on the third floor are the museums, the petrographic laboratory, dark room and storage rooms.

The collection of minerals belonging to the department have been subjected to a two-fold division into museum specimens and student specimens. The student hand-specimens are placed in drawers where they are accessible at all times; the material for laboratory work is kept in a separate cabinet; and the museum collection, which consists of the rarer, larger and more delicate specimens, are kept under glass.

Of general usefulness in all courses of the department are the storage room, the dark room, the lecture room and the office. The office is a capacious room fitted with desks and tables for the convenience of officers of the department, with cabinets for various collections and with bookcases for the departmental library. The lecture room is provided with wall maps, blackboards and suitable desks and chairs. It is thirty-one feet long by twenty-four feet wide. One corner of the room is occupied by a geological relief map of the United States modeled on a section of a globe sixteen feet in diameter. This shows the topography as well as the areal geology of the entire country. A map-case five feet square contains the larger geological and areal maps. The dark room on the third floor contains apparatus and chemicals for photographic work. The storage room on the same floor contains materials for exchange, etc.

Mineralogy and Geology.—An extensive collection of crystals is used not only to illustrate the lectures in crystallography but also as material for laboratory exercise. In addition to these real crystals four series of crystal models are available, two of wood, one of celluloid and one of glass. A reflection goniometer for the accurate measurement of crystal angles is installed in the dark room, while hand goniometers for laboratory work are kept in a case in the mineralogical laboratory.

The main museum occupies the north wing of the third floor of the building in a room thirty feet by sixty feet. Twenty-four large glass cases are devoted to the mineral collections and fourteen additional cases are devoted to ores, rocks, non-metallic products, specimens illustrating geological structures and some of the larger fossils. Five cases are devoted to a special collection of minerals from the Butte district. All mineral collections are arranged according to the Dana classifications. A collection of one hundred and sixty gold crystals is kept in one of the cases. The mineral collections in the museum contain more than three thousand specimens. The systematic rock collection contains over fifteen hundred specimens. The museum in all contains over ten thousand specimens.

The mine model museum occupies a room thirty feet square in the southwest wing of the third floor of the building. Here are to be found many of the classic mine models used in the protracted mining litigation for which the Butte camp has been noted. These models are of many designs and styles and are of much practical use in illustrating the principles and facts of mining geology.

The mineralogical laboratory is thirty-one feet square and contains six laboratory tables capable of accommodating thirty-six students. Each student is provided with complete apparatus for the rapid determination of minerals by physical and chemical tests. A case in one corner of the laboratory contains the students' reference collection, containing over 300 mineral specimens and varieties, arranged according to Dana. Pycnometers, Westphal balances, Plattner scales, burettes and miscellaneous laboratory supplies are at hand in another case. A collection of minerals for laboratory determination by the students is kept in a set of drawers in the office. Here also will be found a case of chemical and mineralogical reagents and appliances, a tile-topped table, a hood and all the apparatus necessary for conducting qualitative and quantitative analysis of minerals and rocks. A Greenough-Leitz binocular microscope is available for the mineralogy laboratory.

The working paleontological collection consists of over two thousand catalogued fossils, systematically arranged in cases in the Museum.

For the work in field geology, the department is equipped with Brunton compasses, clinometers, levels, aneroid barometers, tapes, cameras, field glasses and a complete camp outfit.

Petrography.—In the geological museum is a case containing seventeen petrographic microscopes. Ten of these are of the French type, made by Nachet in Paris; and seven of the German type, made by Leitz at Wetzlar. These microscopes are all provided with the necessary attachments for petrographic work, and the two of them, one Leitz and one Nachet, are of a larger size than the others, and are equipped with accessories for research work. The School owns a fine projection apparatus which is provided with a large petrographic microsccope for use in illustrating lectures in petrography.

A specially constructed cabinet in one corner of the museum contains five hundred slides of minerals, six hundred thin sections of rocks, and one hundred slides of economic interest. The collection of mineral sections is supplemented by eight additional sets of fifteen more important mineral slides put up in individual boxes and a box containing seventeen slides especially prepared for use with the projection microscope.

The thin sections of rock are nearly all represented by hand specimens in the museum collections already described, so that the student may observe the macroscopic character along with his microscopic work. A set of one hundred and four wooden models of crystals of the more important rock-forming minerals is also contained in the thin-section cabinet; while a collection of twenty glass models of rock-forming minerals after Grubenmann occupies a wall case.

The thin-section lathe room contains complete equipment for making thin sections of rocks and minerals, and for polishing opaque minerals. There are two electrically driven lathes in this room; one is provided with two laps for rough and fine grinding respectively; the other with a diamond wheel for cutting slides, and with two emery wheels for grinding. Emery, Canada balsam, thick glass, slides, covers and all other supplies and accessories are at hand for use.

A camera for taking photo-micrographs is installed in the dark room.

DEPARTMENT OF MECHANICS.

This department occupies three rooms on the first floor. The lecture room has a seating capacity of forty persons, and is provided with modern lecture room conveniences, such as water, gas, electric current, etc. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound and light. The physical laboratory is equipped with heavy tables and apparatus for the measurement of physical contants. The apparatus consists of the usual assortment required in the measurement of density, elasticity, force of gravity, the latent heats of fusion and evaporation, the mechanical equivalent of heat, etc. There is also a good photometer, together with the necessary accessories. For the measurements in electricity, there are provided ammeters, voltmeters, resistanc boxs, Wheatstone bridges, galvanometers, batteries, keys, etc.

An engine and dynamo laboratory is located in the basement of the building; there is installed here a gas engine of ten horsepower for experimental purposes. A ten horsepower three phase induction motor drives direct and alternating current dynamos. A switchboard connects these machines with lines running to various parts of the building, also to motors and a rotary converter, and to a bank of transformers. It is possible to illustrate most of the connections in power transmission systems with the apparatus at hand as well as to perform many interesting tests. A storage battery of ten cells is also connected to the switch board so that any number of them may be connected to any of the circuits for lecture or experimental purposes. It is charged from the direct current dynamo or mercury arc rectifier. The requisite voltmeters and ammeters for both alternating and direct currents, rheostats, etc., are provided. The laboratory is also supplied with galvanometers, standard condensers, resistance boxes, etc., necessary for the more exact and complicated electrical measurements.

The power plant for the mill contains two 80 horse-power boilers, a 75 horsepower high speed engine belted to a 50 K. W., three-phase generator with switchboard and necessary instruments, and an air compressor with steam cylinders 8-inch by 10-inch and air cylinders 7½-inch and 13-inch by 10-inch.

In connection with this laboratory there is a small shop equipped with the following metal working machines: One thirteen-inch screw cutting lathe; one sixteen-inch shaper; one twenty-two-inch drill. The tool cabinets are provided with a good equipment of bench tools for both metal and wood work. There is also a small blacksmith shop used for making and repairing tools and for giving such students as may desire it, practice in forge work in iron and steel.

In addition to the material mentioned above the testing laboratory has at its disposal a 100,000-pound Olson machine arranged for tensile, compression, and shearing tests. The accessories consist of the following: One compression micrometer especially designed for measuring the compression of stone cubes and other building material; one improved deflection instrument for measuring the deflection of beams subject to load; one Henning's improved micrometer instrument for measuring the compression or elongation of long specimens. The laboratory is also equipped with a cement testing outfit from Fairbanks Morse & Co. All accessories, such as molds, sieves, etc., are at hand for making a thorough study of this important subject. The apparatus for making a complete indicator and brake test of an engine are provided, also the apparatus for making a study of the heating power of coals.

THE LIBRARY

CHARLOTTE RUSSELL, LIBRARIAN.

The library is located on the second floor of the main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers with its alcoves a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast, and Geodetic Surveys; Reports on Forestry, Forest Reserves, and Irrigation; of the Naval Observatories; Engineering Corps, and Bureau of Mines. Besides these the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the more important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound and thus furnish in permanent form, more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and periodical issues of other colleges.

LIST OF STUDENTS.

SENIOR CLASS.

Cannon, Frank D.	Gibbonsville, Idaho
Carlisle, Stanley B.	Winfield, Kansas
Cheung, T. C.	Hong Kong, China
Collins, Thomas F.	Butte
Freshman, Herman	Butte
Gabisch, Francis	Helena
Gaethke, Fred P.	Butte
Lee, L. P.	Hong Kong, China
Ling, Tao	Honan, China
Norton, John E	Butte
Parker, Howard	Butte
Sparks, Karl T.	Butte
Tseo, G. B.	Kiangse, China
Vivian, George F.	Butte
Wilkinson, Thomas	Butte

JUNIOR CLASS.

Achuck, Warren W.	Honolulu, Hawaii
Cliff, Frank M.	Butte
Cole, Glancy W.	Butte
Davis, Homer F.	Eagle Grove, Iowa
Ellingwood, C. W., Jr.	Butte
Loughran, David E.	Butte
McAuliffe, Charles, Jr.	Butte
Makinson, Roy	Butte
Nelson, A. S.	Sunne, Sweden
O'Donnell, Neil	Butte
Petritz, William E.	Rockford, Illinois
Pierce, Wilbur C.	Arthur, Nevada
Spiegel, Sam	Butte
Thrasher, Willard	Butte
Vaupell, C. W.	Lewistown

SOPHOMORE CLASS

Anderson, Ernest	Anaconda
Bartzen, Clarence	Butte
Bogen, Alfred T.	Lewistown
Courtney, Edward	Butte
Engel, Abe	Butte
Fredell, Clarence	Anaconda
Guernsey, Elmon B.	Butte
Heatherly, Sam	Red Lodge
Milkwick, Clifford F.	Anaconda
Miller, K. Earl	Creswell Oregon
Newton, Claude	Butte
Peterson, John N.	Terraville, S. D.
Ryburn, Robert M.	Granbury, Texas
Symons, Henry	Butte
Werelius, Walter W.	Butte
Whealdon, Alfred N.	The Dalles, Oregon

FRESHMAN CLASS.

Beall, Cy D.	Roberts
Beck, Robert W.	Portland, Oregon
Burrell, Roger A.	Choteau
Davies, Fred	Butte
DeMordant, Paul	Butte
Elder, Robert A.	Miles City
Emery, Lawrence W.	Bozeman
Feeney, Walter	Butte
Foran, William T.	Seattle, Washington
Freshman, Walter C.	Butte
Griffiths, Morgan	Butte
Hale, Emmet	Butte
Hoss, Fred W.	Helena
Howard, Vincent	Portland, Oregon
Kitto, Cyrus	Butte
Leasman, Archie	Hector, Minnesota
Lyden, Martin	Butte
McNaul, James	Butte
MacMillan, Duncan	Butte
Manning, Leslie B.	Butte
Masel, George	Butte
Miilu, Raymond	Houghton, Michigan
Mueller, Ernest	Butte
Renouard, Edward I.	Butte
Rowe, Francis A.	Butte
Shenon, Kenneth	Salmon, Idaho
Shenon, Philip	Salmon, Idaho
Taylor, Maurice	Anaconda
Whitehead, Guy C.	Mason City, Nebraska
Wilson, Curtis L.	Anaconda

SPECIAL STUDENTS.

Curran, Francis R.	Butte
Hussey, George W.	Spokane, Washington
Lightfoot, James E.	Soldier, Idaho
Lowe, Robert	Kirkwood, Mo.
Markham, Stephen	Fitchburg, Mass.
Mason, V. V.	Helena
Morgan, Ray S.	Spokane, Washington
Schulz, B. Max, Jr.	Seattle, Washington
Scott, Samuel G.	Butte
Shanley, Mrs. T. J. B.	Butte
Taylor, Nicholas	Sheridan
Youtz, R. B.	Mountville, Pennsylvania

REGISTER OF ALUMNI

Adami, Arthur E., 1907........Butte, Montana
Asst. Professor of Mining Engineering, Montana State School of Mines.

Aline, Peter A., 1915........Great Falls, Montana
New Furnace Refinery, B. & M. Reduction Dept. A. C. M. Co.

Andrew, John T., 1912........Butte, Montana
Lawyer.

Archibald, George B., 1905........Portland, Oregan
Carey Act and Mineral Inspector, General Land Office, Department of the Interior.

Balmford, Alfred J., 1904........Warren, Arizona
Mining Engineer, Calumet & Arizona Mining Co.

Bassett, Arthur F., 1912........Huntington, W. Va.
Sales Engineer, Mine Car Division, Hyatt Roller Bearing Co.

Bender, Louis V., 1903........Anaconda, Montana
General Superintendent, Washoe Reduction Works, A. C. M. Co.

Bovett, C. A. 1907........Mason, Nevada
Mining Engineer, Mason Valley Mines Co.

Bowden, Malcolm, 1908........Helena, Montana

Brinton, Owen F., 1905........Quapaw, Oklahoma
Manager of Mines, Admiralty Zinc Company.

Brulo, William, 1909........Helena, Montana
State Land Examiner for Montana.

Christian, Otta B., 1912........Butte, Montana
Draughtsman, A. C. M. Company.

Clinch, R. S., 1911........Nacozari, Sonora, Mexico
Smith & Clinch, Contractors, working Promontario Mine.

Clinch, W. D., 1912........Butte, Montana
Metallurgical Assistant, Timber Butte Milling Co.

Cohan, Jesse, 1912........Butte, Montana
Mining Engineer, Timber Butte Milling Co.

Cole, Robert J., 1914........Butte, Montana
Safety Engineer, North Butte Mining Co.

Cooke, Hamilton, Jr., 1912........St. Joseph, Missouri
Cashier, St. Joe Branch, New York Life Insurance Co.

Corey, C. R., 1905........Seattle, Washington
Asst. Professor of Metallurgy, College of Mines, University of Washington.

Crittenden, Zar T., 1913........La Pas, Manitoba, Canada
Cullity & Crittenden, Mining Engineers.

Cullity, Emmet R., 1912........Deer Lodge, Montana
Superintendent Butte-Deer Lodge Mining Co.

Curran, F. R., 1916........Butte, Montana
Mining.

Dobson, Chris G., 1913........Ray, Arizona
Engineering Dept., Ray Consolidated Mining Co.

Dugan, J. F., 1906........Butte, Montana
Foreman Nettie Mine, A. C. M. Co.

Duling, J. F., 1904........Los Angeles, California
General Engineering Practice.

Duthie, J. M., 1905........Libby, Montana
Private Practice, Mining & Civil Engineering.

Elford, B. E., 1905........Anaconda, Montana
Chemical Laboratory, Washoe Reduction Works, A. C. M. Co.

Ellis, Willis H., 1908........Butte, Montana
Field Assistant to Commissioner of Public Works to City of Butte.

Evans, James R., 1909..........Tshikapa, Conge Belge, West Africa
Formaniere Mission Kasai. via Boma-Luibo

Feeney, Charles M., 1906..........Butte, Montana
County Surveyor, Silver Bow County.

Foote, Frank A., 1908..........Butte, Montana
Operator, Butte & Superior Mining Company.

Fowler, George M., 1912..........Butte, Montana
Geologist, A. C. M. Company.

Gidel, Murl H., 1912..........Butte, Montana
Geologist, A. C. M. Company.

Gieser, H. S., 1906..........Anaconda, Montana
Flotation Operator, Washoe Reduction Works, A. C. M. Co.

Gilham, Ralph, 1909..........Townsend, Montana

Giovanetti, Ettore, 1912..........Butte, Montana
Instructor, Butte Business College.

Goodell, Luther T., 1915..........Butte, Montana
Miner, Speculator Mine, North Butte Mining Co.

Grunert, August, 1910..........Butte, Montana
Assayer, A. C. M. Company.

Grupe, Charles W., 1912..........Miami, Arizona

Haines, Peter A., 1909..........Rivermines, Missouri
Superintendent Doe Run Lead Company.

Hanson, Wilbur W., 1913..........Butte, Montana
Mining Engineer, A. C. M. Company.

Hill, W. J., 1916..........Ray, Arizona
Engineering Dept., Ray Consolidated Copper Co.

Hogan, Eugene, 1916..........Butte, Montana
Engineering Dept., A. C. M. Company.

Hunt, John E., 1915..........Butte, Montana
Testing Dept., Timber Butte Milling Co.

Ireland, Arthur J., 1904.
Deceased.

Jensen, Walter H., 1910..........Great Falls, Montana
With Montana Brewing Company.

Johns, John W., 1906..........Marysville, Montana
Foreman Gloster Mine, Barnes King Company.

Johnstone, J. Clark, 1909..........Butte, Montana
Mining Engineer.

Kane, Edward G., 1909..........Butte, Montana
Asst. Foreman Bell Mine, A. C. M. Co.

Kane, L. M., 1906..........Butte, Montana

Ketcham, S. H. 1908..........Missoula, Montana
General Practice, Civil & Mining Engineering.

Kirby, Kenneth P., 1909..........Butte, Montana
Mining Engineer, A. C. M. Company.

Kuphal, Henry E., 1904..........Wallace, Idaho
Consulting Mining Engineer.

Lind, A. Leslie, 1916..........Butte, Montana
Assayer, A. C. M. Company.

Lomas, E. Percy, 1908..........Butte, Montana
Mining Engineer.

Loughran, Michael, 1909..........Butte, Montana
Mining Engineer, A. C. M. Company.

Lowry, J. M., Jr., 1908..........Butte, Montana
Engineer, Montana Power Company.

Lyden, Joseph P., 1914..........Butte, Montana
Geologist, A. C. M. Company.

Lyon, Thomas T., 1916..........Butte, Montana
Geologist, A. C. M. Company.

McCool, Edward J., 1913.......Butte, Montana
Mining Engineer, A. C. M. Company.

McCrackin, R. H., 1907.......Cerro de Pasco, Peru
Cerro de Pasco Mining Co., Ltd.

McElvenny, Linden T., 1911.......Butte, Montana
Rancher.

McGee, John, 1904.......Tonopah, Nevada
General Manager Greenwater Copper Mines; Great Western Cons. Mining Co., and Tonopah Bonanza Mining Co.

McLaughlin, William D., 1908.......Butte, Montana
Surveyor, Tramway Mine, A. C. M. Company.

McMahon, Brandon P., 1914.......Butte, Montana
Clerk to Supt. West Stewart Mine, A. C. M. Co.

Mackel, Louis C., 1905.......Whitehall, Montana
Farmer.

MacPherson, Frank H., 1914.......Butte, Montana
Engineering Department, A. C. M. Co.

MacRae, Lachlan D., 1904.......Nacozari, Sonora, Mexico

Malloy, Emmet E., 1908.......Butte, Montana
State Land Examiner.

Manwaring, Joseph H., 1913.......Butte, Montana
Superintendent Butte-Ballaklava Copper Co.

Meiklejohn, Archie B., 1908.......Los Angeles, California
Distribution Accountant Southern California Edison Co.

Murphy, Joseph G., 1914.......Butte, Montana
Geologist, Butte & Superior Mining Co.

Murphy, James K., 1911.......Anaconda, Montana
Superintendent of Roasting Plant, Washoe Reduction Works, A. C. M. Co.

Newton, Lucian, 1913.......Silver Star, Montana
Lessee, Green-Campbell Mine.

O'Brien, Albert, 1908.......Phillipsburg, Montana
Mine Foreman, Bi-Metallic Consolidated Mining Co.

O'Connor, C. H., 1911.......Butte, Montana
Testing Engineer, Timber Butte Milling Co.

Patten, Earle B., 1908.......Phillipsburg, Montana
Mining Engineer; County Surveyor Granite County.

Pauly, P. L., 1904.......Butte, Montana
Draftsman, Timber Butte Milling Company.

Peter, Ira B., 1909.......Butte, Montana
Asst. City Engineer, Butte, Mont.

Peterson, Peter E., 1911.......Butte, Montana
Supt. Illinois Exploration Co.
Consulting Engineer, Butte Elk Park Extension Mining Co.

Pierse, Edwin A. 1913.......Great Falls, Montana
Distributor, Chevrolet and Oakland Automobiles.

Pilger, Theodore F., 1912.......Butte, Montana
Mining Engineer, Butte & Superior Mining Co.

Pratt, A. F., 1913.......Portland, Oregon

Pratt, Paul D., 1905.......Libby, Montana
Custom Work, Mining & Civil Engineer.

Proctor, M. D., 1908.......Truly, Montana
McNair & Proctor Ranch Company.

Proctor, I. O., 1908 .... Butte, Montana
Metallurgical Engineer, Timber Butte Milling Company.

Reardon, D. J., 1907 .... Butte, Montana
With Reardon & Sons, Contractors and Engineers.

Reber, Bert A., 1915 .... Corbin, Montana
Engineer, Corbin Copper Company.

Reese, Clara Clark, 1904 .... Long Beach, California

Reid, Milton A., 1913 .... Butte, Montana
Chief Chemist, Washoe Sampler.

Roach, James, 1911.
Deceased.

Schaefer, W. A. 1907.
Deceased.

Schiffner, Otto B., 1908 .... Tonopah, Nevada
Foreman, Great Western Consolidated Mining Co.

Sheedy, John W., 1915 .... Butte, Montana
Experimental Flotation Laboratory, Butte & Superior Mining Co.

Shields, E. Floyd, 1911 .... Butte, Montana
Mining Engineer, Butte & Superior Mining Co.

Steele Chester H., 1916 .... Butte, Montana
Geologist, A. C. M. Company.

Stevenson, Isabel Little, 1904 .... Richmond, Virginia

Stevenson, L. C., 1905.
Deceased.

Stockett, Norman A., 1909 .... Bonne Terre, Missouri
Engineering Dept., St. Joseph Lead Company.

Strang, Willie B., 1916 .... Butte, Montana
Boss Sampler, Blackrock Mine, Butte & Superior Mining Co.

Stuewe, William, Jr., 1910 .... Gold Hill, Oregon
Mining.

Sultzer, H. Duke, 1911 .... Butte, Montana
Asst. Engineer, A. C. M. Company.

Tallant, Harry S., 1904 .... Palma Sola, Florida
Farmer.

Ternouth, Blaine, 1914 .... Butte, Montana
Electrician, A. C. M. Company.

Tout, Charles, 1911 .... Butte, Montana
Chemist, Mines Operating Company

VanGundy, J. E., 1905 .... Phillipsburg, Montana
Manager Montana Manganese Company.

Villars, Jesse R., 1908 .... Great Falls, Montana
General Practice, Civil and Mining Engineer.

Walton, Lee M., 1908 .... Great Falls, Montana
Manager Wardrobe Company.

Warfield, Hershel, 1906 .... Los Angeles, California
Stocks and Bonds.

Watson, Robert A., 1915.
Deceased.

Wiegenstein, Henry J., 1909 .... Butte, Montana
Mining Engineer.

Williams, Paul, 1912 .... Kellogg, Idaho
Construction Engineer, Bunker Hill Smelter.

Wilson, T. Bert, 1906 .... Goldendale, Washington
City Engineer; Manager of Garage.

Wong, Samuel C., 1916 .... Honolulu, H. I.
Engineer, W. Achuck's Ranch, Plantation and Estate.

Woodworth, Guy T., 1915 .... Butte, Montana
Asst. Engineer, East Butte Copper Mining. Co.

Wren, A. A. 1908 ....

Young, A. B. 1906 .... Canille, Arizona
Mining Engineer, Private Practice.

Young, S. A., 1906 .... Astoria, Oregon

Young, Wm A., 1909 .... Maiden, Montana
Lessee Maginnis Mine.

Zentner, Arthur A., 1912 .... Great Falls, Montana
Superintendent Zinc Roasting Plant, B. & M. Electrolytic Zinc Plant, A. C. M. Company

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PUBLICATIONS OF THE UNIVERSITY OF MONTANA

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Each series of the Bulletin is issued quarterly, and contains annual reports, catalogues, etc.

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2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
4. Experiment Station Series.
5. Normal College Series.
6. School of Mines Series.
7. Alumni Series.

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IV. UNIVERSITY OF MONTANA SYLLABI

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3. Normal College Series.
4. School of Mines Series.

BUTTE MINER CO., PRINT

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1917/18

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UNIVERSITY OF ILLINOIS

UNIVERSITY OF MONTANA
SCHOOL OF MINES SERIES No. 2

Montana State School of Mines

Eighteenth
Annual
Catalogue

For 1917-1918

ANNOUNCEMENTS
For 1918-1919

BUTTE, MONTANA

THE UNIVERSITY OF MONTANA

Edward C. Elliott, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913).

The general control and supervision of the University are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

MONTANA STATE BOARD OF EDUCATION

S. V. Stewart, Governor	Ex-Officio President
S. C. Ford, Attorney General	Ex-Officio
May Trumper, Supt. of Public Instruction	Ex-Officio Secretary

C. H. Hall	(1918)	W. S. Hartman	(1920)
J. Bruce Kremer	(1918)	C. E. K. Vidal	(1920)
Leo H. Faust	(1919)	John Dietrich	(1921)
W. H. Nye	(1919)	A. L. Stone	(1921)

The University comprises the following institutions, schools and departments:

THE STATE UNIVERSITY AT MISSOULA

Established February 17, 1893, and consist of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The Summer Session
The Biological Station (Flathead Lake)
The Public Service Division
Special War Courses—
  Military Service Course (1 yr.)
  Nurses' Preparatory Course (1 yr)
  Office Training Course (1 yr.)
The Graduate Department

E. O. Sisson, President

THE STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS AT BOZEMAN

Established February 17, 1893, and consisting of

The College of Agriculture
The College of Engineering
The College of Applied Science
The College of Household and Industrial Art.
Courses for Vocational Teachers
The School of Music
The Summer Session
The Secondary Schools—
  Home Economics
  Mechanic Arts
  Agriculture
The Agricultural Experiment Station
The Agricultural Extension Service
Special War Courses—
  Military Service Course (1 yr.)
  Nurses' Preparatory Course (1 year)
  Office Training Course (1 yr.)

James M. Hamilton, President

THE STATE SCHOOL OF MINES AT BUTTE

Established February 17, 1893

Charles H. Bowman, President

THE STATE NORMAL COLLEGE AT DILLON

Established February 23, 1893, and consisting of

The Two Years Elementary Course
The Three Years Course
The Four Years Course
The Rural Teachers' Course

Joseph E. Monroe, President.

For publications and detailed information concerning the different schools and colleges, address the President of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA
SCHOOL OF MINES SERIES No. 2

Montana State School of Mines

Eighteenth
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For 1917-1918

ANNOUNCEMENTS
For 1918-1919

BUTTE, MONTANA

1918

JULY

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1920

JANUARY

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JUNE

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SCHOOL CALENDAR 1918-1919

1918

September 3, First Semester begins.
November 8, Close of First Term.
November 11, Second Term, First Semester begins.
December 20, Holiday Recess begins.

1919.

January 6, Holiday Recess ends.
January 17, End of First Semester.
January 20, Second Semester begins.
March 28, End of First Term, Second Semester.
March 31, Second Term, Second Semester begins.
June 6, Commencement Day.
September 2, First Semester begins.

EXECUTIVE BOARD

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Professor of Metallurgy.

Lester J. Hartzell, E. M.
Professor of Chemistry.

Arthur E. Adami, E. M.
Assistant Professor of Mining Engineering

M. F. Haley,
Assistant Millman.

Historical Sketch

An Act of Congress approved February 18th, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22nd, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana, in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1st, 1916.

LOCATION

The Montana State School of Mines is located in Butte, just inside the city limits on the west. The site on the southern bench of "Big Butte," the extinct volcano from which the city takes its name, was donated by certain public-spirited citizens. It is easily accessible, one of the lines of the street railway company running within a few blocks. The location is most commanding and the view from the grounds overlooks the city, mines and smelters, as well as the mountains which form the continental divide and which surround the valley on the east and south.

BUTTE

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city by the leading financiers and mining men of this country and Europe have given this locality such publicity that no one now needs to be told of its leading position in the mining world.

The great reduction plants that have heretofore handled the ore that comes from the mines of this city are being enlarged to treat the increased product. The modern devices for reducing the expense of treatment will be developed on a larger scale, and all of this increase in every department of the mining industry goes to render this place the more desirable as a location for a mining school.

In a very important sense all these mining plants of every description are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of this industry and are thoroughly conversant with the details of the work.

EXCURSIONS

To secure a more thorough and practical acquaintance with the subjects taught in the School of Mines, frequent excursions are made to some of the extensive mining and metallurgical plants in the vicinity of the School.

It is believed that the location of the Montana State School of Mines is unrivalled in the opportunities it offers for such excursions. While in most other mining schools a journey of several hundred miles must be made, at heavy expense to the student, if he wishes to investigate the practical application of the methods and processes employed in the mine and smelter, the opportunity is here presented for daily observation of work, the development and product of which have given to Butte the reputation of being the greater mining center in the world.

The excursions are made by the students of the School under the guidance of instructors, at such times in their course as may be most advantageous to them; but, besides these regular occasions, through the kindness of the managers of the various plants, whenever an operation of unusual interest or importance is about to take place, permission is given to the mining classes to witness the same, under the guidance of these instructors.

Short excursions are also made from time to time to regions near-by which illustrate the geological features of the Rocky Mountain system.

In addition to these comparatively short excursions, the sophomores spend eight weeks in the field, where they are given fifteen hours per week in learn the use of surveying instruments, and in such exercises as are detailed under special description of courses. The juniors, in like manner, spend fifteen hours per week for eight weeks in underground surveys, in the mines, under the direction of the professor in charge of mining engineering, and in map drawing to show underground workings. In like manner, the seniors spend four weeks making geological surveys in several of the interesting fields of this and adjoining States.

Through the courtesy of the great mining companies, as well as the smaller operators and individual miners, the students of the School of Mines have every proper opportunity of visiting these mining plants and observing the operations therein conducted. The great practical advantage that thus accrues to the mining student cannot be overestimated.

BUILDINGS

In 1895 a Building Commission was appointed and authorized by the Legislature to issue bonds, the proceeds of which were to be used for the erection of a suitable building for the School. The issue of bonds returned the amount of $120,000.00, and during 1895 and 1897 a four-story pressed brick building was erected. This main building measures one hundred and eighteen feet along the front; the depth is ninety-four feet. There are 37,000 square feet of floor space utilized in class rooms, laboratories, etc. The basement floor is given up to chemical and metallurgical laboratories and to a mechanical testing laboratory. The next two floors containing the recitation rooms, the drafting rooms, the mineralogy laboratory and the library. The fourth floor is given up mainly to museums containing extensive collections of minerals, mine models and exhibits illustrating geology. There is also a petrographic laboratory on this floor, where ample table room is supplied, together with requisite cabinets of rock specimens, thin sections, etc.; the laboratory contains the machines necessary to cut rock and mineral sections.

The Legislative Assembly of 1907 appropriated $59,000.00 for a new heating plant and an additional building to be equipped as an ore-dressing and metallurgical plant. The second building was completed in 1908 and measures seventy feet by one hundred and ten feet. The building is now equipped to handle large quantities of ore conveniently, offering treatment by most of the standard processes now in practice, a detailed account of which may be found under the proper heading. The mill building contains the steam and electric power plant which supplies power to the mill and affords a fine laboratory in this line for instruction and practice for the students.

The gymnasium building is the latest acquisition to the school's equipment, being erected in 1910. It is constructed along the established line of architecture and measures eighty-seven feet by fifty feet. The building contains one large gymnasium hall seventy feet by forty-five feet, at one end of which is a balcony with a seating capacity for 100 people. The hall may also be used as a general auditorium on special occasions. Connected with the gymnasium are two parlors, a dressing room, and in the basement a room equipped with shower baths, toilets, etc.

MAINTENANCE

The maintenance of the Montana State School of Mines is provided for by the State through biennial appropriations made by the Legislative Assembly. The sum provided for the biennium ending February 28, 1919, is $77,000.00.

The aim of the Montana State School of Mines is to furnish the best possible education to those whose life work will be devoted to mining in any of its branches. The School is therefore wholly a technical one, not providing an education for the business man, the farmer, or the literary man, but confining its energies entirely to the proper mental equipment of mining men. The course of study, which is fully described in the following pages, has been elaborated with this purpose constantly in mind.

EXPENSES

Fees.—By the Act establishing the School of Mines, no charge of tuition is to be made where the student is a bona fide resident of Montana. Students from other states or counties will pay a tuition fee of $25.00 per semester, or $50.00 per year.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

Deposits.—To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each student is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is the list of deposits that are required:

FRESHMAN YEAR.

General Chemistry and Qualitative Analysis	$15.00

SOPHOMORE YEAR.

Plane Surveying	$10.00
Quantitative Analysis	15.00
Mineralogy	5.00

JUNIOR YEAR.

Mine Surveying	$10.00
Assaying	10.00

SENIOR YEAR.

Metallurgy	$15.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or its vicinity, and at such places as approved by the faculty. The expense for board and lodging is not higher than in other important cities of the west. Good board can be secured at $25.00 per month, while the cost of a good room large enough for two persons and including light and heat will be from $15.00 to $25.00 per month, according to the location and the furnishings. Cost of text-books average about $25.00 a year. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as found here.

In accordance with the provisions of Chapter 123 of the Session Laws of 1917, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round-trip between his Montana home and any institution of the University of Montana once each year, will be refunded. No war tax paid by any student will be refunded under any circumstances whatever, but students whose fare exceeds five dollars, by applying in advance to the Registrar, may obtain blanks, by the use of which exemption from the tax on transportation may be secured.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance to the freshman class. This must include at least fifteen units of work. The term unit means one subject pursued for at least thirty-six weeks with not fewer than five recitations per week of forty-five or more minutes each. Two periods of laboratory, shop or drawing work count the same as one recitation.

Of the fifteen units required, three are required in mathematics, distributed between algebra and plane and solid geometry; three are required in English composition and literature; and one is required in physics.

ADMISSION ON CERTIFICATE

Graduates of the accredited high schools of Montana obtain admission by presenting certificates of principals stating subjects taken, time given for each and grades obtained.

Blanks for such certificates are furnished by the Registrar. These should be filed in the Registrar's office on or before the first day of registration.

LIST OF ACCREDITED HIGH SCHOOLS, 1917-1918.

DISTRICT HIGH SCHOOLS: Alberton, *Anaconda, Baker, Belgrade, Belt, *Billings, Bridger, *Butte, Camas Prairie, *Chinook, Columbia Falls, *Columbus, Conrad, Corvallis, Culbertson, Cutbank, *Forsyth, Fromberg, * Glasgow, *Great Falls, *Hamilton, Hardin, Harlowton, *Havre, *Helena, Hysham, Joliet, Laurel, Lavina, Libby, Malta, Moore, Plains, Plentywood, Polson, Pony, Potomac, Ravalli, Roundup, Ryegate, Shelby, Sheridan, Sidney, Stanford, Stevensville, Terry, Thompson Falls, Three Forks, Valier, Victor, Virginia City, Whitefish, Whitehall, White Sulphur Springs, Worden.

COUNTY HIGH SCHOOLS: *Beaverhead (Dillon); Broadwater (Townsend); *Carbon (Red Lodge); *Choteau (Fort Benton); *Custer (Miles City); *Dawson (Glendive); *Fergus (Lewistown); *Flathead (Kalispell); *Gallatin (Bozeman); *Granite (Philipsburg); Jefferson (Boulder); Lincoln (Eureka) *Missoula (Missoula); *Park (Livingston); *Powell (Deer Lodge); *Sweet Grass (Big Timber; *Teton (Chouteau); Wibaux (Wibaux).

PRIVATE SCHOOLS: Academy of Montana Wesleyan University (Helena); Academy of Mount St. Charles College (Helena); Butte Business College (Butte); Central High School (Butte); Loyola High School (Missoula); Mount Angela Ursuline Academy (Great Falls); Polytechnic Institute (Billings); Sacred Heart Academy (Missoula); St. Vincent's Academy (Helena).

Preparatory work done in other schools than those accredited may receive credit. Applicants from such schools should present certificates stating the same points as those given from accredited schools. Blanks for this purpose are furnished by the Registrar. When the evidence of certificate is not clear and satisfactory, examinations will be given.

Graduates of high schools not in Montana are admitted on certificates without examination if such high schools are accredited to their own state universities.

*—These schools are accredited by the North Central Association of Colleges and Secondary Schools for the year 1917-1918.

ADMISSION ON EXAMINATION.

Applicants wishing to receive entrance credits on subjects for which they do not present satisfactory certificates are required to take examinations on days prescribed in the calendar. For the academic year 1918-1919 these days are September 3 and January 20.

Those who are preparing to take entrance examinations should correspond with the Registrar for suggestions in regard to such preparation.

ADMISSION OF SPECIAL STUDENTS

Students 21 years of age or older, not candidates for degrees, may be admitted without the usual entrance units, as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired.

Special students may acquire status as regular students and become candidates for degrees upon complying with the rules applicable to such cases.

ADMISSION TO ADVANCE STANDING

Students entering from collegiate departments of other colleges and universities must bring certificates of honorable dismissal. Upon presentation of the proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

REQUIREMENTS FOR GRADUATION

The School confers the degree of Mining Engineer upon those who have completed the course as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

HIGH SCHOOL HONOR SCHOLARSHIPS

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana it is the declared policy of the State Board of Education to provide for the awarding of scholarships to be known as "High School Honor Scholarships" to graduates of the accredited high schools of the State.

In the administration of this policy the number of scholarships awarded each year in any accredited high school will depend upon the number of graduates, as hereinafter specified. In no case, however, will more than two such scholarships be awarded each year in any high school for any one of the institutions of the University. High School Honor Scholarships may be awarded only to students who belong to the highest one-fourth of the graduating class in scholarship.

The following general regulations will govern the awarding of High School Honor Scholarships:

1. Upon the presentation of the required certificate from the principal, the Chancellor of the University will authorize the award, each year, to graduates of each of the accredited public high schools of the state, of High School Honor Scholarships for the component institutions of the University of Montana.

2. To be eligible for a High School Honor Scholarship the individual must be certified by the principal:

(a) To be a graduate of an accredited high school of the state;
(b) To belong to the highest one-fourth of his class in scholarship.
(c) To be a student of ability and promise of success in college or professional school; and
(d) To be the highest in scholarship of those members of the graduating class desiring to attend the University institution for which the honor scholarship is to be awarded.

3. No more than one honor scholarship may be awarded to the membership of any graduating class having seven or fewer graduates; no more than two scholarships may be awarded to the membership

of any graduating class having eight to eleven graduates; no more than three scholarships may be awarded to the membership of any graduating class having twelve to fifteen graduates; no more than four scholarships may be awarded to the membership of any graduating class having sixteen or more graduates.

4. No more than two High School Honor Scholarships may be awarded each year in any high school for any one of the institutions of the University.

5. The holders of High School Honor Scholarships shall be exempted from the payment of all customary fees except the student activity fees and the special fees in the School of Music. All holders of High School Honor Scholarships will be expected to make the required course deposits.

6. Any High School Honor Scholarship will become void unless the holder enters one of the institutions of the University within eighteen months after graduation from the high school. The holder of a High School Honor Scholarship must give notice to the Registrar of the institution of his intention to utilize the scholarship not later than September 1st of the year in which he intends to enter the institution.

7. Any High School Honor Scholarship will be valid only as long as the holder is in attendance upon some regular course leading to graduation; provided, however, that no High School Honor Scholarship shall be valid for a period longer than five years.

8. In case any individual to whom has been awarded a High School Honor Scholarship relinquishes the scholarship without entering the institution, or for any reason fails to enter the institution in compliance with Section 6 of these regulations, the high school principal may certify the next ranking eligible member of the same graduating class desiring to enter the particular institution.

9. The privileges of a High School Honor Scholarship may be retained only so long as the holder maintains a standard in scholarship and regularity of attendance satisfactory to the faculty of the institution at which he is in attendance.

MILITARY SERVICE SCHOLARSHIPS.

Upon the proper certification of the president that a student has rendered military or navy service to the nation and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service Scholarship to such student. The holders of such scholarships, throughout the course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

GENERAL UNIVERSITY STUDENT LOAN FUNDS.

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds which are available for students in the junior and senior classes of any of the institutions of the University of Montana who are unable to continue their studies without financial aid and are satisfactorily recommended as to character and scholarship by the dean or director or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loans must be repaid within one year from the time of borrowing or, in exceptional cases, one year after graduation. Loans bear two per cent interest.

Application blanks and a statement of detailed regulations governing these loans may be obtained from the Registrar.

COURSE OF STUDY.

FRESHMEN YEAR

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Higher Algebra	3	3
Trigonometry	5	5
Chemistry Lectures	3	3
Chemistry Laboratory	6	6
English	2	2
Descriptive Geometry	2	2
Mechanical Drawing	9	9

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Analytical Geometry	5	5
Plane Surveying, Theory	3	3
Descriptive Geometry	2	2
Chemistry Lectures	3	3
English	2	2
Chemistry Laboratory	9	9
Mechanical Drawing	6	6

SOPHOMORE YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Calculus	5	5
Physics	5	5
Chemistry, Lectures	2	2
Chemistry, Laboratory	0	9
Mineralogy, Lectures	3	3
Mineralogy, Laboratory	0	6
Topographical Drawing	15	0
Plane Surveying, Field Work	Four Weeks	0

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Calculus, Anal. Mechanics	5	5
Physics	4	4
Chemistry, Lectures	1	1
Chemistry, Laboratory	9	9
Mine Surveying, Theory	2	2
Mineralogy, Lectures	3	3
Mineralogy, Laboratory	6	6

JUNIOR YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mechanics	5	5
Mining	2	2
Geology	5	5
Metallurgy, Lectures	3	3
Mine Surveying, Practice	15	0
Engineering Design	0	9
Graphics	0	6

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mechanics and Hydraulics	5	5
Mining	2	2
Geology, Lectures	5	5
Metallurgy, Lectures	3	3
Engineering, Design	6	3
Geology, Laboratory	3	3
Assaying	6	6
Mining, Laboratory	0	3

SENIOR YEAR.

First Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Economic Geology	5	5
Mining	2	2
Ore Dressing	0	3
Metallurgy	3	3
Mechanical Engineering	5	2
Geology, Field Work	0	3
Metallurgical, Laboratory	15	6
Engineering Design	0	6

Second Semester.

	First Term Hours per Week.	Second Term Hours per Week.
Mining	3	3
Ore Dressing	2	2
Metallurgy	3	3
Metallurgy, Laboratory	6	6
Power Transmission	3	3
Engineering Construction	2	2
Engineering Design	6	6
Mining Law	2	0
Mining Geology	5	5

ENGLISH

PROFESSOR C. H. BOWMAN

Two hours per week during the Freshman year are allotted to the study of English composition. The work is designed to continue the training outlined in the usual high school course, the chief aim being to create an individual and effective means of expression and communication for the ordinary demands of professional life. The ability to express oneself accurately and with some degree of elegance is an advantage which is not easily overestimated. At the same time the stimulating of literary sympathy and appreciation is kept in view. This we deem especially desirable in a professional course, as it supplies an element which is a source of pleasure in after life.

The work begins with a series of classroom lectures and discussions, during which time the students are given simple exercises in writing; special attention is given to grammar, punctuation, choice of words, etc. Finally this work is extended to the study of the paragraph and the more complete theme.

During the latter part of the year the class is organized to develop the debate, together with the regular theme writing. Proper form and fluency in speaking to an audience is a matter cultivated throughout the year. Among the other helpful features of the course may be mentioned a thorough and practical drill in parliamentary law instruction on note taking, on making outlines, on writing examination papers and on the use of the library. The reading assignments for critical study are drawn mainly from the best technical magazines, from the best editorials, while occasionally a book of purely literary merit is assigned for review.

MATHEMATICS

PROFESSORS CRAVEN AND BOWMAN, ASST. PROFESSOR ADAMI

Algebra.—A preliminary course is first given, designed to drill the student in the fundamental algebraic operations and in the statement and solution of simple mechanical problems. This review is followed for the remainder of the semester by a careful study of those operations of advanced algebra which will be of use to the student in future engineering courses. Special attention is given to the theory and use of exponents and logarithms, simultaneous quadratic equations, the more common series with their practical applications, indeterminate coefficients and quantics solved by synthetic division and by graphical methods. Text, "Higher Algebra," by H. E. Hawkes.

Freshmen first semester, three hours per week.

Trigonometry.—In plane trigonometry the subjects of primary importance are: Goniometry; solutions of right and oblique triangles, and practical problems; and in spherical trigonometry the solution of the right and oblique spherical triangles is developed and practical application is made to surveying and mensuration. Text, Wentworth's "Plane and Spherical Trigonometry."

Freshmen, first semester, five hours per week.

Analytical Geometry.—This course from its very nature becomes a thorough review of algebra, geometry, and trigonometry. The material gathered from these three sources is combined in a most striking way, which leads to a practical working knowledge of these branches of mathematics. The student is required to study and plot accurately numerous problems covering such topics as the point and straight line in a plane, different system of co-ordinates, conic sections, higher plane curves, the point and straight line in space, curved surfaces, and surfaces of revolution. Toward the end of the course the student is required to study various mechanical movements to devise movements and to determine the laws and equations involved, Text, "Analytical Geometry," by H. B. Philips.

Freshmen, second semester, five hours per week.

Calculus.—Among the topics studied in this course may be mentioned differentiations, tangents, normals, subtangents, subnormals, asymptotes, indeterminate forms, logarithms, maximi and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text, Taylor's "Differential and Integral Calculus."

Sophomores, throughout the year, five hours per week.

GEOLOGY AND MINERALOGY

PROFESSOR CLAPP

Mineralogy.—The purpose of the course in Mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests and by sight is the object sought. The course is presented by means of lectures and recitations, laboratory practice, museum study, and by short field trips for the purpose of collecting minerals and observing their mode of occurrence. The course is subdivided into Crystallography, Blowpipe Analysis, and Determinative, and Descriptive Mineralogy.

Crystallography is first studied by means of lectures, recitations and laboratory practice in the identification of natural crystals and models. Its aim is to familiarize the student with the principles of the subject and to enable him to identify crystallographic forms and their combinations. Blowpipe analysis is also preparatory to determinative mineralogy and its aim is to train the student in the use of the blowpipe and in the rapid methods of qualitative analysis suitable for the determination of elements in minerals.

The instruction in descriptive and determinative mineralogy consists of lectures, recitations and laboratory work. At first about seventy-five of the most important minerals are identified and their physical and chemical properties carefully determined and described in the laboratory. This work is supplemented by the lectures and recitations on the character, distinguishing features and occurrences of about two hundred minerals. The final and most important work consists in the rapid identification of about a thousand specimens of one hundred and fifty minerals, as far as possible by sight methods or by methods applicable in the field. Text, Ford-Dana's "Manual of Mineralogy."

Sophomores, first semester, first term, three hours per week.
Sophomores, first semester, second term, nine hours per week.
Sophomores, second semester, nine hours per week.

Geology.—The principles of geology are developed through lectures, field excursions and laboratory exercises. Physiographic, dynamic, and structural geology are first studied, followed by a brief outline of historical geology and geology of North America. Montana geology is given particular attention. The needs of the mining engineer are kept constantly in mind and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text, Pirsson and Schuchert's "Textbook of Geology."

Juniors, first semester, five hours per week.
Juniors, second semester, eight hours per week.

Economic Geology.—The course in economic geology takes up the more theoretical aspects of the geology of ore deposits, including structural features, the transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment, by means of lectures, recitations, and exercises. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and non-metallic, especially those of North America, is gained by the preparation of reports and maps. Field trips are made to mines and quarries to supplement the classroom work. Text, Lindgren's "Mineral Deposits."

Seniors, first semester, five hours per week.

Field Geology.—A course in the various methods of geological surveys, including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared during a three weeks' field course, but material for laboratory study is collected and geological reports are written.

Seniors, first semester, three hours per week.

Mining Geology.—This course consists of two weeks of field work in the principles and practice of underground geologic mapping. Reports are prepared on the mines examined and lectures are given on the application of geology to mining problems.

Seniors, second semester, five hours per week.

CHEMISTRY

PROFESSOR HARTZELL

General Chemistry.—The subject of General Chemistry is presented in lectures and textbooks.

The object of the course is to develop the underlying principals of the subject as a basis for all subsequent work in the department. The student is made familiar with the principal characteristics and relations of the elements one to another, the work being illustrated by experiments conducted by the instructor. In this work the student is directed to read from text-book references, and it is essential for those who take the course to take notes on the lectures which are designed to aid and direct the work performed in laboratory practice during the semester. The text book used is "General Chemistry for Colleges," by Alexander Smith.

Freshmen, throughout the year, three hours per week.

General Chemistry, Laboratory.—The course of laboratory study in this subject consists of performing a number of experiments by the students at individual desks. This course is designed to teach the student the use of the various kinds of apparatus, chemical agents and reagents, besides becoming familiar with their reactions and relations with each other. A neatly-kept note-book is essential in this work, in which is kept a record of the statement, reactions and principles involved in each experiment.

Freshmen, first semester, six hours per week.
Freshmen, second semester, nine hours per week.

Qualitative Analysis.—This course is designed to instruct the student in the general scheme of analysis by which the different metallic elements are detected and separated from each other. The more common acid radicals, their identification and isolation also forms a part of the course.

Lectures accompany the work, giving a general outline of the schemes, separations, etc., dealing with the merits and difficulties of each, finally pointing out the most satisfactory proof in each case. The essential element of writing and balancing equations is a part of the drill work in class-room exercise. Chemical Arithmetic or Stoichiometry is also taught during the latter part of the second semester.

The text-book used is "Qualitative Analysis," by Prescott and Johnson.

Freshmen, second semester, three hours per week.

Quantitative Analysis.—This course is designed to meet the needs of the mining engineer in the pursuit of his profession. It embraces all the general analyses, such as analysis of limestone, dolomites, rock analysis, ores of iron, manganese, lead, zinc, arsenic, copper and many others, such as the analysis of artificial substances, among which are given, mattes, slags, flue dust, concentrates, roasted ore (calcines) and pig iron and steel.

The subject of acidimetry and alkalimetry is taken up and explained. Analyses are made of different substances to demonstrate this subject.

The work in chemistry throughout is conducted with a view of developing rapid and accurate work on the part of the student. The problems and laboratory work are selected as far as possible from the work of the practitioner in the mining districts, especially of the West. While these practical features are employed the instructor bears it ever in mind that through all the work the student must be required to use his own talents and learn to think and reason for himself.

Sophomores, first semester, second term, two hours per week and six hours laboratory.

Sophomores, first semester, second term, one hour lecture per week and nine hours laboratory.

Sophomores, second semester, one hour lecture per week and nine hours laboratory.

METALLURGY

PROFESSOR PULSIFER, MR. HALEY

General Metallurgy.—The study of Metallurgy is introduced with lectures and recitations intended to present the science and industry in its full scope and relationship to modern civilization. In following out this purpose the students learn the Status of Metallurgy in General, the Properties of Metals, the Constitution of Metals, and the Nature of Alloys. After these preliminary subjects those principals and phases which can be advantageously grouped and compared in a general way are studied. These topics include Minerals and Ores, Reducing the Metals, Refining the Metals, Sampling, Pre-Treatment of Ores, Furnaces, Fuel and Combustion, Refractories, Slags, Dust and Fume and Gas, Flues and Stacks, Plant and Plant Organization, Plant Equipment, Scientific Instruments, Hygiene, Safety and Welfare, Economics.

It is intended that this first course shall awaken the student to a keen interest in the subject, enable him to grasp the meaning and importance of the entire subject and lay a foundation for the following courses which treat of the individual metals and alloys in considerable detail. Collateral readings and satisfactory notebooks are required.

Juniors, first semester, first term, three hours per week.

Metallurgy of Copper.—The study of the metallurgy of copper is conducted by lectures and recitations covering the subject fully. The electrolytic refining of copper bullion is studied as a part of this course. Immediately after the subject is treated in the lecture and recitation rooms, one week is devoted to a practical study of smelter and electrolytic refinery at Anaconda or at Great Falls. Each operation in the treatment of copper ores is studied in detail, among them may be mentioned the processes of concentration, the production of matte by both reverbertory and blast furnace; the blowing of matte to metallic copper in the converter and the process of refining copper in the reverberatory refining furnace. Most of the standard models of concentration, roasting and reduction of copper ores are studied during these visits. A typewritten report of the operations observed is required of each student. The text-book used is Peter's "Practice of Copper Smelting."

Juniors, first semester, second term, three hours per week.

Metallurgy of Gold and Silver—The second semester of the junior year is devoted to the metallurgy of gold and silver. The methods of obtaining gold by dredging and sluicing are treated briefly. The larger portion of the time is taken up with a rather detailed study of the cyanide process from both a chemical and economic standpoint. The various methods of crushing, classifying and treatment of sands and the slimes are treated quite fully. The modern devices for handling the sands and filtering the slimes are studied. The other metallurgical processes for silver, such as the Washoe process and the hyposulphite lixiation process, are discussed briefly. The course is completed by a two weeks' excursion to visit the various cyanide and other plants, where a careful study is made of the process and a detailed typewritten report is made by each student. The subjects are presented through lectures and assigned reading.

Juniors, second semester, three hours per week.

Metallurgy of Lead and Silver.—The subject of the metallurgy of lead is studied during the first semester of the senior year and is presented through lectures and assigned reading. The work first covers a historical sketch of the various processes, and finally covers a detailed study of all the reactions, devices and processes found in the modern lead smelting plant. The processes of roasting, the blast furnace practice and the refining of bullion are given full consideration. The class is also given some experience in making all necessary calculations.

Following the course the class is taken to a lead smelter and required to make a detailed study of all departments, submitting a written report of the examinations made at the works.

Seniors, first semester, first term, three hours per week.
Seniors, first semester, second term, two hours per week.

Iron and Other Metals.—The metallurgy of iron and steel is presented through lectures and text-book study. Stoughton's Metallurgy of Iron and Steel being the text in present use. Special attention is given to the value of the various ores and metals and others elements used in the manufacture of alloy metals. In addition to the methods of manufacture of iron and steel into the standard forms of commerce, considerable attention is paid to the testing of these products and their uses.

The metallurgy of zinc is covered by a series of lectures where the processes of roasting and retort smelting are fully explained. Attention is also given to the manufacture of the retorts and other devices used about the works.

This course also includes a study of the uses of zinc, together with the uses and manufacture of its alloys.

The latter part of the senior year is staken up with a series of lectures and student reports covering the metallurgy of other metals of commercial importance; among them may be mentioned the metallurgy of tin, nickel, cadnium, aluminum, etc. The careful and thorough study of the preceding metals forms a basis of knowledge about furnaces, metallurgical reactions, etc., which permits an easy understanding of the special features involved in each of the subjects taken up in this course.

The students' part of the work is accomplished through references to standard works and special articles found in the publications in the library.

Seniors, second semester, two hours per week.

Fire Assaying.—The course in fire assaying is essentially a laboratory drill course. It comes during the Junior and Senior years when the students are familiar with the reagents and most of the chemical reactions used in the work. However, the laboratory work is preceded by a short course in lectures in which the general principles of the art are developed and all equipment carefully explained. Attention is given to the proper care of the furnace and method of controlling the temperature. The special balances used in this work are demonstrated, showing methods of operating, care and adjustments. Finally the class is given a series of notes which embody a description of the charge in actual use in the mining and smelting plants of the West.

In the laboratory work each student is given a desk with a full equipment of reagents and apparatus. Ample furnace room, balances and ore-grinding apparatus are provided, so no delays are encountered through lack of equipment. Then each student works through his individual list of ores to be assayed. There are silicious oxidized ores, basic oxidized ores, ores of lead, copper and zinc, all containing various impurities. These are assayed for gold and silver and when lead is present it is also determined. The smelter products likewise receive attention; lead and copper mattes, speiss, antimonial lead, lead and copper bullion, lead and copper slag are treated according to the custom about the laboratory of the smelter.

Both crucible and scorification methods are used where considered practicable, while the combined wet and dry methods are used upon material such as copper bullion, mattes high in copper, blister copper, etc.

The laboratory work covers about twenty weeks of two afternoons each week. Throughout the course speed and accuracy are considered essential points. Before a student is considered proficient he must be able to accomplish what may be considered a reasonable day's work in a commercial laboratory. Accuracy is required, but it is not sufficient; speed is considered equally important.

In this course no charge is made for materials or equipment except where there is an unnecessary breakage or consumption of material.

Juniors, second semester, two afternoons per week.

Metallurgical Laboratory Practice.—The work of the first term of the Senior year includes the systematic investigation of a large variety of commercial ores for the purpose of determining in each case the most economical metallurgical process for the recovery of the precious or base metals. In connection with this work the students have access to special laboratory equipment of the most approved type for ore testing on a miniature scale. Recent additions to this laboratory include a slide-testing machine for the study on a reduced scale of the oil-flotation process; a large porcelain pebble mill for all-sliming operations, grinding in solution and chlorination work; special air agitation apparatus for the cyanide treatment of refractory ores and concentrates; individual vacuum filters, and a small Kelly filter press for the study of problems involving the slime filtration and washing.

A small lot of uncrushed ore, generally not less than fifty pounds, is given to each student, who first makes a careful physical examination indicating the minerals containing the precious or base metals, those composing the gangue, nature of the ore and such characteristics as might have a bearing on the particular line of investigation to be followed. An accurate sample is then prepared, assayed and analyzed for the usual constituents determined in metallurgical practice. A scheme of treatment is then outlined and the results obtained are systematically tabulated, forming the basis of an individual report on the economical treatment of the ore in question.

Experience gained in previous years' work in mineralogy, assaying and metallurgical analysis is made frequent use of in this course, and accordingly no student will be admitted unless qualified in these subjects.

Special emphasis will be given to processes of current interest open to important future developments such as the recovery of values from refractory gold and silver ores and concentrates, oil flotation methods and hydrometallurgical treatment of copper ores. There is practice work in amalgamation, concentration, chloridizing roasting, hyposulphite leaching, magnetic separation and dry chlorination.

Seniors, first semester, first term, five afternoons per week.

Metallurgical Mill Practice.—Data obtained in the metallurgical laboratory during the first semester forms the basis of actual mill tests during the balance of the school year, the aim being to duplicate on a commercial scale the results previously obtained from laboratory samples.

For this work there are crushers, rolls, mills, etc., so arranged as to reduce the handling of ore to a minimum.

A battery of three stamps offers practice in stamp milling, during which tests the class is given practice in dressing the plates and recovering bullion. Other tests involve the use of amalgamating pans, cyanide vats of three tons capacity, a slime and agitation equipment, a lead-lined agitation barrel for chlorination work. There are also roasting furnaces with which any of the roasting operations may be carried out that are required in the standard processes of ore treatment.

During this work much attention is given to the handling and adjusting of machinery. Under proper instruction the students operate the mill from the power plant to the tailings dump. This experience is a valuable asset to any young engineer undertaking work, especially with the smaller plants of the West, since mining engineers, even if they are not metallurgists, are frequently called on to operate ore dressing or milling plants. The course also gives excellent opportunity for gaining experience in methods of sampling.

One hour each week is devoted to a discussion of the principles involved in each of the milling operations and individual reports are read and commented upon.

Seniors, first semester, second term, two afternoons per week.

Seniors, second semester, two afternoons per week, conferences one hour per week.

MECHANICS.

PROFESSORS CRAVEN AND BOWMAN

Physics.—Throughout the course in physics the student's attention is directed to a systematic development of the principles of the science. Lectures are aided by demonstrations in which phenomena are shown and later laboratory work is given. While the general subjects of physics is covered, it is the aim to develop most thoroughly such parts as add directly to the working knowledge of the mining engineer.

During the first semester the student acquires an analytical knowledge of the mechanics of solids and fluids. Principles and fundamental methods are considered of great importance in this elementary course.

Among the topics considered may be mentioned: Concurrent and parallel forces; center of gravity; resistance and work; simple machines; gravity and motion; inertia and rotation. Numerous problems are solved during this course. In the mechanics of fluids the fundamental principles are developed by lecture demonstrations. During the latter part of the semester the subject of heat is introduced; aside from the nature and measurement of heat, its application to the steam engine and to the transmission of energy by means of compressed air is considered. Text, Jameson's "Elements of Practical Mechanics."

Sophomores, first semester, six hours per week.

Physics.—The second course in physics includes a thorough study of the elements of electricity and magnetism and a brief study of light and sound. The principles and application of electricity to dynamos, motors, the transmission of energy, lighting, etc., are the most essential parts of the course. The work in light includes a study of optical instruments and of the phenomena met in the study of mineralogy and petrography.

During the last term of the semester the class work of the year is supplemented by practice, four hours per week, in the laboratory. Constants in the domain of mechanics and heat are determined and a familiarity is acquired with simple electrical measurements, the running and behavior of dynamos and motors, etc. Text: Jackson's "Elementary Electricity and Magnetism."

Sophomores, second semester, four hours per week.

Applied Mechanics.—This course is a sequence to the analytical mechanics, which is made a part of the integral calculus. The laws of elasticity and resistance of materials are studied and applied to the proportioning of pipes, cylinders and riveted joints. The general theory of beams, including cantilever, continuous and restrained, is given and the graphical solutions are developed as well as the analytical solutions. The application to columns or struts is developed and to shafting for transmitting power. Special subjects are taken up which are of interest to the engineer, such as resilience and work, impact and fatigue, true and internal stresses. Many problems are solved, selected from engineering practice to illustrate the theory developed. The course also includes a study of the properties and uses of various building materials, the metals, timber, stone, brick, cement, etc.

It is the object of this course to direct the student's attention to the elements of the design of mining machinery. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keys, pipes and pipe fittings, shafting, couplings and supports for shafts. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, rope, gearing, etc. Special attention is given to the installation and maintenance of machinery, and in this connection a great deal of practical information is obtained by frequent visits about the repair shops of the mines of Butte. Text: Merriman's "Mechanics of Materials."

Juniors, first semester, five hours per week.
Juniors, second semester, two hours per week.

Hydraulics.—A knowledge of this subject is of importance to the mining engineer, especially to one whose field of labor is in the West. The course is introduced with a brief review of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involved in the study of the flow of water through orifices, over weirs, through pipes, flumes and conduits. Attention is given to the elements of design of dams and adjuncts. The immense use of water-power for lighting, mining and transportation purposes prompts an investigation of the various turbine, impulse wheels and governing devices. Text: Merriman's "Treatise on Hydraulics."

Juniors, second semester, three hours per week.

Mechanical Engineering of Power Plants.—The discussion of the power plant is preceded by a course of lectures and recitations on Thermodynamics. Attention is paid to definitions and units in the domain of heat, work and power. The laws of thermodynamics are thoroughly developed and numerous related problems are solved. Following this course a systematic study is made of the mechanism of engines, non-condensing, condensing, simple and continuous expansion, valves and valve gearing with their various governing attachments. foundations, bed plates, etc. Steam boiler types are studied, together with their setting and management. The designing and construction of chimneys and the general plans for power houses are also made a part of this course. Text: "Steam Engines and Boilers" by J. H Kinealy.

During this course a series of lectures is offered, essentially descriptive of pumps and pump details, special attention being given to the construction and management of mining pumps. The course is based on "Pumping Machinery," by William M. Barr.

Seniors, first semester, second term, three hours per week.
Seniors, first semester, first term, five hours per week.

Power Transmission.—The extensive use of electrical power, together with the abundant water supply for power purposes. The elementary principles are laid down during the sophomore year. In the senior year the student's attention is directed to the general conditions of power transmission, power transmission by electrical energy, synchronous and induction motors, current reorganizers, hydraulic development, the organization of a power station, line construction, centers of distribution, the commercial problems and measurements of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this line of engineering. Text: "Power Transmission," by Bell.

Seniors, second semester, three hours per week.

Graphics.—The work of Graphics follows the Junior course in mechanics. The course is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind, snow, etc. Analysis is made of single-span trusses of various types with horizontal chords, trusses with inclined chord, and continuous trusses. In these problems concentrated and uniform loads are considered, stresses due to a locomotive, also stresses due to the wind, etc. The work is carried on in the drawing room, supplemented by lectures and recitations. "Steel Mill Buildings," by Ketchum, is used as a basis. Twelve practical problems are presented and solved in the drawing room.

Juniors, first semester, second term, six hours per week.

Engineering Construction.—This course consists of lectures and recitations on modern practice in engineering construction. Among the subjects covered may be mentioned: Details of mill building, both frame and steel; construction of retaining walls, foundations, dams, ets., cement, reinforced concrete. The lectures deal with the many practical points in construction and in the handling and care of material. Text: Ketchum's "Steel Mill Buildings."

Seniors, second semester, two hours per week.

MECHANICAL DRAWING AND MACHINE DESIGN

PROFESSOR CRAVEN, ASSISTANT PROFESSOR ADAMI

Mechanical Drawing.—The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. The beginner in this subject should supply himself with first-class instruments; a good set will serve him for years after his course in school is completed, while an inferior set will cause annoyance and loss of time almost from the beginning. The student should consult the instructor in charge in regard to the kind and number of instruments necessary.

Throughout this course the student applies himself in the drawing room, becoming familiar with the use of drawing instruments and the elements of projections and sections. He is required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to him. While the instructor is always present to assist and see that no time is lost in useless endeavor, it is the aim to guard against the copying of drawings; the student must learn to think and construct for himself. A short time of each period is given to the rapid drawing of problems previously assigned in descriptive geometry. The course also includes practice in free-hand lettering. "Mechanical Drawing," by Faunce and "Descriptive Geometry," by Faunce, are the text-books used.

Freshmen, first semester, nine hours per week.

Mechanical Drawing.—The second course in mechanical drawing continues the subject laid down in the first course. The study of descriptive geometry is completed and applied to more difficult problems. During this course the student is taught the use of water color as applied to engineering drawings, practice is given in coloring maps and shading parts of machine drawings. As far as possible the problems in drawings are taken from those met by the mining engineer in practice; when the student completes his course he is equipped with drawings of the standard timber sets used in mines, with drawings of shaft timbers, head frames and machine drills with the conventions used in mine and geological maps, and many other useful items used in mining.

Freshmen, second semester, six hours per week.

Descriptive Geometry.—Two hours per week throughout the Freshman year are occupied with recitations in descriptive geometry. Throughout the course the students study assigned lessons from a text-book, together with the notation work, etc. The class period is taken up for the most part with the working of new problems, especially those involving point, line, and plane; it is a drill hour in rapidity and accuracy in the application of the essential features of the subject. The procedure insures a thorough mastery of all the elements, an acquisition which is of great value in much of the work of the mining engineer. It assists him in his mechanical drawing and designing, it is indispensible in many problems in mine surveying and aids greatly in part of the work in geology, especially in the practical work in mines where faults and veins are traced and platted.

In the latter part of the work, where the more complicated intersections of solids and the developments of surfaces are required, the class works in the drawing room. Here the problems are likewise varied so that the possibility of merely copying or committing to memory are eliminated. The course follows in close touch with the regular mechanical drawing where the more elaborate drawings are completed, dimensioned and inked. Text: Faunce's "Descriptive Geometry."

Freshmen year, two hours per week.

SURVEYING AND TOPOGRAPHICAL DRAWING

PROFESSOR SIMONS, ASSISTANT PROFESSOR ADAMI

Plane Surveying—Lectures and recitations, including description of surveying instruments, their construction, adjustment, use and care. Form of field notes for different methods of surveying, computation of bearings, co-ordinates, elevations, areas, quantities of material, from data secured in the field. Solution of problems in surveying requires a thorough knowledge of algebra, geometry and trigonometry. Practical use of surveying instruments on the school grounds. Algebra, trigonometry and the use of logarithms are prerequisites.

Freshmen, second semester, three hours per week.

Mine Surveying.—A course of lectures on underground surveying and shaft plumbing. The course also includes the mathematical and graphical solution of numerous surveying problems.

Sophomores, second semester, two hours per week.

Plane Surveying, Field Work.—A course of practical surveying in the field. During their stay in the field the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets, etc. Determination of true meridian by solar observation and by observation on Polaris. Traverse survey with transit and steel tape, angles by repetition, azimuth and deflection. Problems in public land surveying in accordance with Manual of Instruction to United States Deputy Surveyors. Official survey of mining claims in application for United States patent; returns to consist of letter of transmittal, plat, field notes and computations, in form of transmission to United States Surveyor General. Topographic survey with transit and steel tape. Stadia and trigonometric survey. Base line and triangulation. Leveling for profile for contour lines and for establishment of bench marks. Staking out buildings and excavations for foundations and calculation of quantaties to be excavated. Survey of ditch or flume line. Preliminary and location survey of railroad.

Sophomores, first semester, first term, four weeks.

Mine Surveying, Field Work and Mine Mapping.—A course of practical mine surveying at a mine in actual operation. During their stay at the mine the students plumb the shaft, make a complete survey of the underground workings, as well as of all important surface features, such as buildings, ore bins, tracks, claim boundaries, and streets. After the completion of the field work the students return to the class room, where all necessary calculations are made for the final plotting of the field notes, such as true bearings, horizontal distances, latitudes, and departures, co-ordinates and elevations. The graphical work includes a composite map showing the underground workings, the surface plant, the claim lines, and city streets. In addition to this the students make a number of sections, showing the occurrence of the ore bodies, the position of shafts, levels, cross-cuts, stopes, and their vertical relation to the underground workings.

Juniors, first semester, first term, fifteen hours per week.

Topographical Drawing.—The work consists in platting on a convenient scale the surveys executed in the field by the Sophomores. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps, mills, etc. The students also receive directions in the construction of contour lines and in laying out railroads and wagon roads, dams, reservoirs, flumes, ditches, etc., on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, etc., by cross sections made from such contour maps. In this work special attention is given to lettering, titles, borders and north points, and general neatness in execution.

Sophomores, first semester, first term, fifteen hours per week.

MINING, ORE DRESSING AND ENGINEERING DESIGN

PROFESSOR SIMONS, ASSISTANT PROFESSOR ADAMI

Mining.—An outline of the geographical and geological distribution of the ores of the useful minerals. Prospecting, discovery, locating and acquiring title to mining claims. Breaking ground by the various methods of hand work, rotary and percussion drills. Explosives and their uses. Supporting excavations by timbering, masonry and metallic supports. The lectures and recitations are illustrated by drawings, prints, models and frequent visits to the local mines, where the mining operations are observed.

Juniors, first and second semester, two hours per week.

Mining Laboratory Practice—One afternoon a week is spent in studying air drills, besides making actual tests on various kinds of drills, such as air consumption, rate of drilling, efficiency tests and cost of operating. In addition to the above the students take trips underground to make a study of the practical side of mining. Special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drills and boring by percussion drills.

Juniors, second semester, second term, one afternoon per week.

Mining.—Air compression. Prospecting for placer deposits. Exploitation of gold placers by various methods, including hydraulicking and dredging. Water supply for hydraulic and other mining operations. Reservoirs, dams, ditches and pipe lines.

Seniors, first semester, first term, two hours per week.
Seniors, first semester, second term, three hours per week.

Mining.—Exploitation of the useful minerals by open work, and the various methods of underground stoping. Mine haulage. Hoisting and hoisting machinery and accessories. Drainage and pumping. Ventilation, natural and artificial. Lighting and sanitary arrangements. The study of mining operations on a commercial scale. The superintendence and management of mines. Selecting and buying supplies and machinery for mining operations. Mining economics and mine accounts. Examination and reporting on mines and mining enterprises.

Seniors, second semester, three hours per week.

Ore Dressing.—Lectures and recitations. The object and general principles of ore dressing. Stamp milling, followed by amalgamation and concentration. Description of the construction and operation of the principle types of crushers, stamps, classifiers, concentrating tables and accessories. The lectures are amplified by frequent visits to local mills and ore dressing plants and by practical tests in the school laboratory.

Seniors, first semester, second term, two hours per week.

Ore Dressing.—A study of the physical laws governing the various processes of ore dressing, the laws of crushing, of jigging, of free and hindered settling. The principles of screen sizing and hydraulic classification. Study of the construction and operation of typical milling machinery, rolls, grinding mills, jigs, tables, vanners, magnetic separators, flotation processes and mill accessories. Power transmission and water supply for milling operations. The study of design and methods of ore dressing at plants visited during the school year. Practical tests in the ore dressing department of the school laboratory.

Seniors, second semester, two hours per week.

The course of Mining and Ore Dressing is completed by a two weeks' excursion to districts where Mining and Ore Dressing methods can be studied which do not prevail in the Butte district.

Mining Engineering Design.—In this work the students are taught to make designs of structures in woods, masonry and metal, such as are required of the mining engineer. These designs include ore and coal bins, railroad trestles, head frames, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems with all conditions and requirements are dictated to the students in the classrooms. Numerous blueprints obtained from actual structures are on file for reference.

Juniors, first semester, second term, nine hours per week.
Junior, second semester, six hours per week.

Mining Engineering Design.—Leading up from the design of single structures this course consists in the design of a complete plant for one or more of the operations of mining and ore dressing. Besides the design and arrangement of a plant for the exploitation of the mine, each student also makes a design of a complete concentrating and stamp mill. It is the aim in this course to develop the originality of the student; although the professor in charge is always present to assist, the student is thrown upon his own resources as far as possible.

He is required to make use of catalogues and reference books to obtain the data necessary for the completion of his problem. Attention is given to assembling, bills of materials, and the item of costs. The problems are given to the students and discussed in the class room.

Seniors, first semester, second term, and second semester, six hours per week.

MINING LAW

JUDGE EDWARD B. HOWELL OF THE MONTANA BAR

A course of instruction on the law relating to mining claims, including the method of acquiring title from the United States to lode, placer, tunnel and mill-site claims in the various states and Alaska, with a comparative study of federal and state laws on the subject, the law relating to extralateral rights, leases, options to purchase, conveyance of mining claims, and water rights, the relative rights of citizens and aliens in the tenure of mining claims. The object of the course is to give the student a good working knowledge of mining law, and to this end students are required to draft location notices and similar instruments that might become necessary in their work in the field. Through the recitations the class is given a thorough drill in rights of the locator, also in ways in which these rights may be transmitted or may be forfeited, all principles being abundantly illustrated by actual and hypothetical cases. Questions of more complexity are illustrated by elaborate models and charts; many of these models were constructed to represent the claims of mining companies in the courts.

The course in Mining Law consists of lectures and recitations covering a period of two months and is required of the Senior class. The class uses as a text-book for the course Mr. Howell's manual on "Lode and Placer Claims."

DIVISION OF UNIVERSITY EXTENSION

During the past year the School of Mines gave an extension correspondence course of twenty lectures and assignments in elementary geology, for which five quarter credits were given.

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of the State. The total sum invested for this purpose now amounts to nearly $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School. The descriptions which follow concern the more important articles that have been procured to illustrate or facilitate the work in the several departments.

DEPARTMENT OF MATHEMATICS

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor, abundantly supplied with blackboard space, terrestrial and celestial globes, some simple models, and a blackboard ruled in squares for tracing the graphs of equations and of natural phenomena.

DEPARTMENT OF CHEMISTRY

In this, as in all other departments where laboratory work is required, the demand for a large and varied equipment of apparatus and facilities for investigation is great, and the successful prosecution of the purpose for which the technical school is maintained is directly related to the perfection of this equipment. Nearly three-fourths of the entire first floor or basement of the School of Mines has been devoted to the use of this department, together with a lecture room on the second floor. In this space four laboratories have been fitted up, one for qualitative and quantitative analysis, one for metallurgy, and two special laboratories. To these have been added a balance room, a store room for laboratory supplies and a dispensary where the prepared tests for the students in the laboratories are kept.

The laboratories are furnished with working desks of the most approved pattern—each student having his own particular stand—where he is supplied with gas, water, blast, Bunsen burners, a rack for chemical reagents and a cupboard with lock and key, so that he can keep securely the apparatus and material assigned for his use. The laboratories are also supplied with hoods, in which are to be found hot plates, air baths, steam evaporating pans, hydrogen-sulphide apparatus and a flue with a strong draft to draw off the noxious vapors. The laboratories for qualitative and quantitative analysis and for metallurgy are sufficient for the accommodation of 48 students each.

The students' balance room is provided with six analytical balances for the use of the student in the laboratories. These balances are placed on piers disconnected from the walls and floors of the building so that the vibration is reduced to a minimum.

The special laboratories and preparation rooms are equipped with modern conveniences for carrying on analytical and metallurgical work. In these rooms all the chemical reagents are prepared for the use of the student in the laboratories and all check analysis on the students' work is made. Two dark rooms are provided for photographic work, spectrum analysis, making blue prints and lantern slides.

The chemical lecture room, local on the second floor, is provided with a demonstrating table, furnished with pneumatic trough, gas, water, hydrogen and oxygen blast and direct and alternating currents of electricity up to 750 volts and 45 amperes. The demonstrating table is backed with a hood furnished with the same appurtenances as are provided for the hoods in the laboratories.

DEPARTMENT OF METALLURGY

The assay laboratory is situated on the first or basement floor of the building, and is equipped with six of the latest model coal assay furnaces. There are also two gas assay furnaces and one gasoline furnace, which can be used for special work, and a gas retort and melting furnace for melting bullion, making alloys, retorting amalgam, casting copper and other anodes, etc.

The pulp room adjoins the assay laboratory, where all charges are weighed and fluxed. Convenient cupboards are provided for storing samples. The silver and gold balances are located in the same room as the analytical balances, and are of the latest approved design.

The crusher room is provided with a Gates crusher, a Low crusher, an Englebach grinder capable of grinding pulp to 80 mesh, a Braun planetary pulverizer, a buckingboard, tables upon which to roll samples, and a series of drawers capable of holding 454 twenty-five-pound pulp samples. The supply of assay samples consists of a large number of copper, lead, gold and silver ores, together with mattes, both copper and lead, slag, flue-dust, calcines, concentrates, tailings, and all smelter products from the copper and lead smelters and other plants of the State.

In the assay laboratory are located separate cyanide outfits for testing ore by the cyanide process. There is also located in this laboratory a calcining furnace capable of being used as a reverberatory or muffle roasting furnace, where large lots can be calcined, or a chlorination roast can be made for hyposulphite treatment.

There are arrangements for treating free milling gold ores by the amalgamation process, as well as cyaniding the tailings from this process.

Gas analysis is at present carried on in the chemical lecture room. There is a very complete set of Hempel's gas apparatus, and analyses are made of gases of combustion, reverbatory and blast furnace, illuminating gases, etc.

A dark room for students' use adjoins the balance room, which contains a large Kirchoff-Bunsen spectroscope and supplementary apparatus for qualitative analytical work in determining the presence of the alkali and alkaline earth metals by their volatilization in the non-luminous flame of the Bunsen burner. The spectroscope is provided with a scale for the determination of the exact location and relative position of the lines of the spectra, or, two spectra may be studied and compared at the same time.

MINING, ORE DRESSING AND METALLURGY

A room 24 by 31 feet is provided on the second floor for lectures in the various branches of mining and ore-dressing. The drawing classes occupy three large, well-lighted rooms. Ample table room and individual drawer room are provided throughout; cabinets for filing drawings and drawing-boards are also provided. A large collection of drawings furnished by various manufacturing companies of mining machinery is on hand and is used as an aid to the student in developing new work. The collection of parts of machines is gradually increasing. The material is of great assistance to the department in developing the work in machine design.

For the practical work in surveying the following instruments have been provided: Ten engineering transits; one from Buff & Buff, two from C. L. Berger & Sons, four from Gurley, one from Keuffel & Esser, one from Young & Son, and one from Eugene Dietzgen. Five levels—one from Buff, one from Gurley, two from Keuffel & Esser, one from Berger, and one from Young & Son. One solar compass and one sextant with artificial horizon, from Gurley; two aneroids by Short & Mason (London), and a collection of minor apparatus, including Brunton compass, clinometers, Locke levels, chains, tapes, plumets, shaft plumbing equipment, rods and flags, necessary in carrying on the work of the department. To this equipment has recently been added by donation a plane table with alidade, a Breithaupt & Sons' level with tripod, and a Tacher's calculating instrument.

A mine model has been constructed in the school shops for use in the lecture room, which greatly facilitates the solving of many of the more complicated problems in mine surveying.

The metallurgical laboratory occupies a building by itself. This building also contains the central heating plant and the engine and dynamo room. The metallurgical laboratory proper occupies a room 77 by 70 feet, half of which is devoted to ore dressing. The ore dressing department consists of a set of storage bins with a capacity of from 80 to 100 tons of ore. One eight-inch by twelve-inch Dodge crusher, two sets of twelve and one-half-inch by twelve-inch rolls, two belt elevators, three trommels thirty inches in diameter and forty-eight inches long, one impact screen for dry screening, a duplex Callow screen for screening to forty and eighty mesh, three Evans and one Hartz jig, one Huntington mill, one Wilfley table, one four-foot Frue Vanner and a Dings magnetic separator. There is also a three-stamp mill with amalgamating table. Accessories consist of classifiers, settling tanks, centrifugal sand and water pumps, etc.

An equipment for making cyaniding tests provides for leaching ores in five-ton lots. In this plant sands and slimes may be separated, dewatered and treated separately. There are five vats and two sump tanks, one steel tank provided with air and mechanical agitators. All necessary filters, zinc boxes, etc., for making commercial tests are installed for use in this plant.

A pan amalgamation plant consists of a Bruckner chloridizing furnace, a pan amalgamator and settling tank. All the usual equipment, such as steam, launders and utensils, etc., are at hand for the convenient working of this plant.

The laboratory contains a Wedge furnace designed to be used as a reverbatory or a muffler furnace. This furnace is mechanically rabbled and used in roasting ores in lots of one ton or more. There is also a lead-lined agitation barrel provided for experiments involving this type of apparatus.

The mill is arranged in such a manner that complete tests on a commercial scale can be made on various kinds of ore by shifting the travel of the ore over such machines as are found to be best suited to treat any particular ore.

The laboratory also contains a miniature testing plant consisting of small-sized jigs, Wilfley table, hydraulic classifiers, automatic feeder, etc., for testing ore in quantities up to four pounds, preliminary to sending the ore through the large mill.

The museum of the school contains a very complete collection of the products from the ore dressing plants at the Butte, Anaconda and Great Falls smelters. These samples are extensively used in lectures on ore dressing, as they show in a most excellent manner the mechanical changes which a particle of ore undergoes during its travel through the various machines designed to separate the valuable metal from its gangue.

On the tables of the library may be found all the leading American technical magazines, as well as many foreign publications. The library also contains a valuable collection of text-books on all the subjects of civil and mining engineering, the use of which is open to all students upon application to the librarian. The office of the Professor of Mining and Ore Dressing also contains a large collection of catalogues, blue prints, and bulletins from leading manufacturers of mining, milling and smelting machinery. The school is indebted to these manufacturers for the supply of such catalogues and for the many extra copies which they have kindly furnished for distribution among the students.

Several mine maps, an ideal section of a Butte copper vein, a very attractive section through part of the Boston and Montana concentrator at Great Falls, and a great number of appropriate photographs and drawings decorate the walls of the museum and library; these include views of Montana mining towns, the Washoe smelter at Anaconda, of the Boston and Montana smelter at Great Falls and of various mines and mills about the State. There is a large drawing to illustrate the method of sampling in use at the Taylor & Brunton Sampling Works (now the Washoe Sampling Works) at Butte, and also several drawings of coal washery of the Cottonwood Coal Company. Finally there are several diagrams, illustrating the relative production of copper, silver and gold in Montana and other states.

The various mine models, donated from time to time by leading mining companies of Butte, are exceedingly useful in demonstrating not only the geological features indicated on such models, but also the various phases and methods of shaft sinking, drifting, cross-cutting and stoping, practiced in the mines represented by said models.

DEPARTMENT OF GEOLOGY AND MINERALOGY.

The department of geology and mineralogy occupies five rooms and part of four others. On the second floor are the office, the lecture room, and the mineralogical laboratory, with provision in the library for certain maps; and on the third floor are the museums, the petrographic laboratory, dark room and storage rooms.

The collection of minerals belonging to the department has been subjected to a two-fold division into museum specimens and student specimens. The student hand-specimens are placed in drawers, where they are accessible at all times; the material for laboratory work is kept in a separate cabinet; and the museum collection, which consists of the rarer, larger and more delicate specimens, are kept under glass.

Of general usefulness in all courses of the department are the storage room, the dark room, the lecture room and the office. The office is a capacious room fitted with desks and tables for the convenience of officers of the department, with cabinets for various collections and with bookcases for the departmental library. The lecture room is provided with wall maps, blackboards and suitable desks and chairs. It is thirty-one feet long by twenty-four feet wide. One corner of the room is occupied by a geological relief map of the United States modeled on a section of a globe sixteen feet in diameter. This shows the topography, as well as the areal geology, of the entire country. A map-case five feet square contains the larger geological and areal maps. The dark room on the third floor contains apparatus and chemicals for photographic work. The storage room on the same floor contains materials for exchange, etc.

Mineralogy and Geology.—An extensive collection of crystals is used not only to illustrate the lectures in crystallography but also as material for laboratory exercise. In addition to these real crystals four series of crystal models are available, two of wood, one of celluloid and one of glass. A reflection goniometer for the accurate measurement of crystal angles is installed in the dark room, while hand goniometers for laboratory work are kept in a case in the mineralogical laboratory.

The main museum occupies the north wing of the third foor of the building in a room thirty feet by sixty feet. Twenty-four large glass cases are devoted to ores, rocks, non-metallic products, specimens illustrating geological structures and some of the larger fossils. Five cases are devoted to a special collection of minerals from the Butte district. All mineral collections are arranged according to the Dana classifications. A collection of one hundred and sixty gold crystals is kept in one of the cases. The mineral collections in the museum contain more than three thousand specimens. The systematic rock collection contains over fifteen hundred specimens. The museum, in all, contains over ten thousand specimens.

The mine model museum occupies a room thirty feet square in the southwest wing of the third floor of the building. Here are to be found many of the classic mine models used in the protracted mining litigation for which the Butte camp has been noted. These models are of many designs and styles and are of much practical use in illustrating the principles and facts of mining geology.

The mineralogical laboratory is thirty-one feet square and contains six laboratory tables capable of accommodating thirty-six students. Each student is provided with complete apparatus for the rapid determination of minerals by physical and chemical tests. A case in one corner of the laboratory contains the students' reference collection, containing over 300 mineral specimens and varieties, arranged according to Dana. Pycnometers, Westphal balances, Plattner scales, burretes and miscellaneous laboratory supplies are at hand in another case. A collection of minerals for laboratory determination by the students is kept in a set of drawers in the office. Here also will be found a case of chemical and mineralogical reagents and appliances, a tile-topped table, a hood and all the apparatus necessary for conducting qualitative and quantitative analysis of minerals and rocks. A Greenough-Leitz binocular microscope is available for the mineralogy laboratory.

The working paleontological collection consists of over two thousand catalogued fossils, systematically arranged in cases in the Museum.

For the work in field geology, the department is equipped with Brunton compasses, clinometers, levels, aneroid barometers, tapes, cameras, field glasses and a complete camp outfit.

Petrography.—In the geological museum is a case containing seventeen petrographic miscroscopes. Ten of these are of the French type, made by Nachet in Paris; and seven of the German type, made by Leitz at Wetzlar. These microscopes are all provided with the necessary attachments for petrographic work, and the two of them, one Leitz and one Nachet, are of a larger size than the others, and are equipped with accessories for research work. The School owns a fine projection apparatus which is provided with a large petrographic microscope for use in illustrating lectures in petrography.

A specially constructed cabinet in one corner of the museaum contains five hundred slides of materials, six hundred thin sections of rocks, and one hundred slides of economic interest. The collection of mineral sections is supplemented by eight additional sets of fifteen more important mineral slides put up in individual boxes and a box containing seventeen slides especially prepared for use with the projection microscope.

The thin sections of rock are nearly all represented by hand specimens in the museum collections already described, so that the student may observe the macroscopic character along with his microscopic work. A set of one hundred and four wooden models of crystals of the more important rock-forming minerals is also contained in the thin-section cabinet; while a collection of twenty glass models of rock-forming minerals after Grubenmann occupies a wall case.

The thin-section lathe room contains complete equipment for making thin sections of rocks and minerals, and for polishing opaque minerals. There are two electrically driven lathes in this room; one is provided with two laps for rough and fine grinding, respectively; the other with a diamond wheel for cutting slides, and with two emery weels for grinding. Emery, Canada balsam, thick glass, slides, covers and all other supplies and accessories are at hand for use.

A camera for taking photo-micrographs is installed in the dark room.

DEPARTMENT OF MECHANICS

This department occupies three rooms on the first floor. The lecture room has a seating capacity of forty persons, and is provided with modern lecture room conveniences, such as water, gas, electric current, etc. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound and light. The physical laboratory is equipped with heavy tables and apparatus for the measurement of physical constants. The apparatus consists of the usual assortment required in the measurement of density, elasticity, force of gravity, the latent heats of fusion and evaporation, the mechanical equivalent of heat, etc. There is also a good photometer, together with the necessary accessories. For the measurements in electrity, there are provided ammeters, voltmeters, resistance boxes, Wheatstone bridges, galvanometers, batteries, keys, etc.

An engine and dynamo laboratory is located in the basement of the building; there is installed here a gas engine of ten-horsepower for experimental purposes. A ten-horsepower three-phase induction motor drives direct and alternating current dynamos. A switchboard connects these machines with lines running to various parts of the building, also to motors and a rotary converter, and to a bank of transformers. It is possible to illustrate most of the connections in power transmission system with the apparatus at hand, as well as to perform many interesting tests. A storage battery of ten cells is also connected to the switchboard, so that any number of them may be connected to any of the circuits for lecture or experimental purposes. It is charged from the direct current dynamo or mercury arc rectifier. The requisite voltmeters and ammeters for both alternating and direct currents, rheostats, etc., are provided. The laboratory is also supplied with galvanometers, standard condensers, resistance boxes, etc., necessary for the most exact and complicated electrical measurements.

The power plant for the mill contains two 80-horsepower boilers, a 75-horsepower high-speed engine belted to a 50 K. W. three-phase generator with switchboard and necessary instruments, and an air compressor with steam cylinders 8-inch by 10-inch, and air cylinders 7½-inch and 13-inch by 10-inch.

In connection with this laboratory there is a small shop equipped with the following metal working machines: One 13-inch screw-cutting lathe; one 16-inch shaper; one 22-inch drill. The tool cabinets are provided with a good equipment of bench tools for both metal and wood work. There is also a small blacksmith shop, used for making and repairing tools and for giving such students as may desire it practice in forge work in iron and steel.

In addition to the material mentioned above the testing laboratory has at its disposal a 100,000-pound Olson machine arranged for tensile, compression and shearing tests. The accessories consist of the following: One compression micrometer especially designed for measuring the compression of stone cubes and other building material; one improved deflection instrument for measuring the deflection of beams subject to load; one Henning's improved micrometer instrument for measuring the compression or elongation of long specimens. The laboratory is also equipped with a cement testing outfit from Fairbanks, Morse & Co. All accessories, such as molds, sieves, etc., are at hand for making a thorough study of this important subject. The apparatus for making a complete indicator and brake test of an engine are provided, also the apparatus for making a study of the heating power of coals.

THE LIBRARY

CHARLOTTE RUSSELL, LIBRARIAN

The library is located on the second floor of the main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers with its alcoves a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others, is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast, and Geodetic Surveys; Reports on Forestry, Forest Reserves, and Irrigation; of the Naval Observatories; Engineering Corps, and Bureau of Mines. Besides these the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the more important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound and thus furnish in permanent form more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and the periodical issues of other colleges.

LIST OF STUDENTS

SENIOR CLASS

*Cliff, Frank M	Butte
*Davis, Homer	Eagle Grove, Iowa
Loughran, David E	Butte
Nelson, A. S	Sunne, Sweden
Petritz, William E	Rockford, Ill.
*Pierce, Wilbur C	Arthur, Nev.
Thrasher, Willard	Butte
*Vaupell, C. W	Lewistown

JUNIOR CLASS

*Anderson, Ernest	Anaconda
Courtney, Edward	**Butte**
Engel, Abe	Butte
*Fredell, Clarence A	Anaconda
*Makinson, Roy	Butte
Milkwick, Clifford F	Anaconda
Newton, C. O	Butte
*Symons, Henry	Butte

SOPHOMORE CLASS

Davies, Fred N	Butte
DeMordant, Paul	Butte
Emery Lawrence W	Butte
Hale, Emmet P	Butte
Mathews, Charles S	Butte
Mueller, Ernest	Butte
Renouard, Edward L., Jr	Butte
Rowe, Francis A	Butte
Taylor, Maurice	Anaconda
Wilson, Curtis L	Anaconda

FRESHMAN CLASS

Blewett, Clarence E	Butte
Charles, Clarence D	Butte
Clifford, James J	Butte
Davey, Ross C	Butte
DeCelles, Arthur	Boulder
Dixon, Charlie B	Butte
Eaves, Lucian, Jr	Butte
Fisher, Samuel	Butte
Girshowsky, Boris D	Kieff, Russia
Hale, Emmet P	Butte
Hayes, Cornelius	Butte

Holland, John G., Jr	Butte
Judge, Joseph A.	Butte
McGonigle, Walter L.	Butte
Merrill, William L.	Butte
Murphy, Pat	Butte
O'Brien, Wallace A.	Butte
Ponish, Frederick H.	Butte
Schubert, Carl Otto	Butte
Shanley, Alice Bernadette	Havre
Thomas, A. P.	Pony

SPECIAL STUDENTS

Bogen, Alfred T.	Butte
Freedman, Alice Naughton	Butte
Taylor, Nicholas	Butte
*Mason, V. V.	Butte
*Vivian, George F.	Butte

Extension Correspondence Students	40

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*Have entered military service during 1917-1918.

REGISTER OF ALUMNI

Adami, Arthur E., 1907........Butte, Mont.
Assistant Professor of Mining Engineering, Montana State School of Mines.

Aline, Peter A., 1915........Great Falls, Mont.
Corporal, Company C, 316th Supply Trains, U. S. Army.

Andrew, John T., 1912........Butte, Mont.
Lawyer.

Archibald, George B., 1905........Jordan Valley, Ore.
Manager, Jordan Valley Project.

Balmforth, Alfred J., 1904........Warren, Ariz.
Mining Engineer, Calumet and Arizona Mining Co.

Bassett, Arthur F. 1912........Newark, N. J.
Engineer, Hyatt Roller Bearing Company.

Bender, Louis V., 1903........Anaconda, Mont.
General Superintendent. Washoe Reduction Works, A. C. M. Co.

Bovett, C. A., 1907........Mason, Nev.
Mining Engineer, Mason Valley Mines Co.

Bowden, Malcolm, 1908........Butte, Mont.
Shift Boss, Elm Orlu Mining Co.

Brinton, Owen F., 1905........Baxter Springs, Texas
Manager, Admiralty Zinc Co., Sinden Zinc Co., Queen Esther Mining Co.

Brulo, William, 1909........Helena, Mont.
State Land Examiner for Montana.

Cannon, Frank D., 1917........Butte, Mont.
Shift Boss, Berkeley Mine, A. C. M. Co.

Carlisle, Stanley B., 1917........Butte, Mont.
Draftsman, Engineering Department, City of Butte.

Cheung, T. C., 1917........Namtu, Northern Shan States, India
Mining Engineer, Burma Mines, Ltd., Burma, India.

Christian Otto B., 1912........Butte, Mont.
Draftsman, A. C. M. Co.

Clinch, R. S., 1911........Nacozari, Sonora, Mexico
Smith & Clinch, Contractors, working Promontario Mine.

Clinch, Walter D., 1912........Butte, Mont.
Metallurgical Assistant, Timber Butte Milling Co.

Cohan, Jesse E., 1912........Butte, Mont.
Mining Engineer, Timber Butte Milling Co.

Cole, Robert J., 1914........Butte, Mont.
Safety Engineer, North Butte Mining Co.

Collins, Thomas F., 1917........Butte, Mont.
Company B, 27th Engineers, U. S. Army.

Cooke, Hamilton, Jr., 1912........Kansas City, Mo.
Agency Organizer, New York Life Insurance Co.

Corey, Clarence R., 1905........Seattle, Wash.
Assistant Professor of Metallurgy, College of Mines, University of Washington.

Crittenden, Zar T., 1913........La Pas, Manitoba, Canada
Cullity & Crittenden, Mining Engineers.

Cullity, Emmet R., 1912........Deer Lodge, Mont.
Flying Cadet, Squadron 39, Aviation Barracks, Berkeley, Cal.

Curran, F. R., 1916........Seattle, Wash.
Employed in the shipyards.

Dobson, Chris G., 1913........Lark, Utah
Company B, 23rd Engineers, U. S. Army.

Dugan, John F., 1906..........Butte, Mont.
Foreman Nettie Mine, A. C. M. Co.

Duling, J. F., 1904..........Los Angeles, Cal.
Captain, Engineers, U. S. R., U. S. Army.

Duthie, John M., 1905..........Libby, Mont.
Captain Engineers, U. S. R., U. S. Army.

Elford, B. E., 1905..........Anaconda, Mont.
Chemical Laboratory, Washoe Reduction Works, A. C. M. Co.

Ellis, Willis H., 1908..........Butte, Mont.
Commission of Public Works, City of Butte.

Evans, James R., 1909..........Tshikapa, Congo Belge, West Africa
Mining Engineer with Societe Internationale Forestiere et Miniere du Congo.

Feeney, Charles M., 1906.
Deceased.

Foote, Frank A..........Kasai, Tshikapa, Conge Belge, West Africa
Mining Engineer.

Fowler, George M., 1912..........Gold Butte, Mont.
Superintendent, C. F. Kelley Gas Operations; Geologist, A. C. M. Co.

Freshman, Herman A., 1917..........Butte, Mont.
Foreman's Clerk, Leonard Mine, A. C. M. Co.

Gaethke, Fred P., 1917..........Basin, Mont.
Assayer and Chemist, Pilgrim Mining Co.

Gidel, Murl H., 1912..........Butte, Mont.
Geologist, A. C. M. Co.

Gieser, H. S., 1906..........Anaconda, Mont.
Flotation Foreman, Copper Concentrator, Washoe Reduction Works, A. C. M. Co.

Gilham, Ralph, 1909..........Townsend, Mont.

Giovanetti, Ettore, 1912..........Butte, Mont.
Bookkeeper, Camp Lewis, Quartermaster Corps, U. S. Army.

Goodell, Luther T., 1915..........Seattle, Wash.
Shipfitter, Skinner & Eddy Shipyards.

Grunert, August, 1910..........Butte, Mont.
Assayer, A. C. M. Co.

Grupe, Charles W., 1912..........

Haines, Peter A., 1909..........Rivermines, Mo.
Division Superintendent, Doe Run Lead Company.

Hanson, Wilbur W., 1913..........Butte, Mont.
Mining Engineer, A. C. M. Co.

Hill, W. J., 1916..........Ray, Ariz.
Battery No. 1, 40th Division, Officers' Training School, Camp Kearney, Cal., U. S. Army.

Hogan, Eugene, 1916..........Butte, Mont.

Hunt, John E., 1915..........Butte, Mont.
Metallurgical Statistician, Timber Butte Milling Co.

Ireland, Arthur J., 1904.
Deceased.

Jensen, Walter H., 1910..........Great Falls, Mont.
Secretary, Montana Brewing Company.

Johns, John W., 1906..........Marysville, Mont.
Superintendent, Shannon Mine, Barnes-King Development Co.

Johnstone, J. Clark, 1909..........Southern Cross, Mont.
Manager, Pyrenees Lease.

Kane, Edward G., 1909..........Butte, Mont.
Foreman, Bell-Diamond Mine, A. C. M. Co.

Kane, L. M., 1906.
Deceased.
Ketcham, S. H., 1908.......... Missoula, Mont.
General Engineering Practice.
Kirby, Kenneth P., 1909.......... Butte, Mont.
Mining Engineer, A. C. M. Co.
Kuphal, Henry E., 1904.......... Wallace, Idaho
Consulting Mining Engineer.
Lind, A. Leslie, 1916.......... Butte, Mont.
First Battery, Company B, 23rd Engineers, U. S. A.
Ling, Tao, 1917.......... Namtu, Northern Shan States, Burma, India
Mining Engineer, Burma Mines, Ltd.
Lomas, E. Percy, 1908.......... Butte, Mont.
Loughran, Michael, 1909.......... Butte, Mont.
Mining Engineer, A. C. M. Co.
Lowry, T. M. Jr., 1908.......... Butte, Mont.
Lyden, Joseph P., 1914.......... Butte, Mont.
Geologist, A. C. M. Co.
Lyon, Thomas T., 1916.......... Butte, Mont.
Geologist, A. C. M. Co.
McCool, Edward J., 1913.......... Butte, Mont.
Mining Engineer, A. C. M. Co.
McCrackin, R. H., 1907.......... Philipsburg, Mont.
Engineer, Granite Bi-Metallic Con. Mining Co.
McElvenny, Linden T., 1911.......... Butte, Mont.
Engineer, City Engineer's Office.
McGee, John, 1904.......... Tonopah, Nev.
General Manager, Greenwater Copper Mines and Smelter Co., Great Western Con. Mining Co., Tonopah Bonanza Mining Company.
McLaughlin, William D., 1908.......... Butte, Mont.
Surveyor, Tramway Mine, A. C. M. Co.
McMahon, Brandon P., 1914.......... Butte, Mont.
Foreman's Clerk, Steward Mine, A. C. M. Co.
Mackel, Louis C., 1905.......... Whitehall, Mont.
Farmer.
MacPherson Frank H., 1914.......... Butte, Mont.
Mining Engineer, A. C. M. Co.
MacRae, L. D., 1904.......... Nacozari, Sonora, Mexico
Engineer, Moctezuma Copper Company.
Malloy, Emmet E., 1909.......... Butte, Mont.
State Land Examiner.
Manwaring, J. H., 1913.......... Butte, Mont.
Superintendent, Butte-Ballaklava Copper Co., County Surveyor of Silver Bow County.
Mason, Veyne V., 1917.......... Helena, Mont.
Twenty-third Engineers, Company B, U. S. Army.
Meiklejohn, Archie B., 1908.......... Los Angeles, Cal.
Distribution Accountant Southern Cal. Edison Co.
Murphy, James K., 1911.......... Anaconda, Mont.
Superintendent, Roasting Department, Washoe Reduction Works, A. C. M. Co.
Murphy, Joseph G., 1914.......... Butte, Mont.
Mine Foreman, Butte and Superior Mining Co.
Newton, Lucian, 1913.......... Silver Star, Mont.
Lessee, Green-Campbell Mine.
O'Brien, Albert, 1908.......... Butte, Mont.
Mining Engineer.

O'Connor, C. H., 1911 .... Butte, Mont.
Testing Department, Timber Butte Milling Company.
Parker, W. Howard, 1917 .... Butte, Mont.
Sampler, Berkeley Mine, A. C. M. Co.
Patten, Earle B., 1908 .... Philipsburg, Mont.
Mining Engineer; County Surveyer of Granite County.
Pauly, P. L., 1904 .... Butte, Mont.
Draftsman, Timber Butte Milling Company.
Peter, Ira B., 1909 .... Butte, Mont.
Mining Engineer A. C. M. Co.
Peterson, Peter E., 1911 .... Sidney Inlet, West Coast Vancouver
Mill Superintendent. Island, B. C.
Pierse, Edwin A., 1913 .... Great Falls, Mont.
Automobile Jobber.
Pilger, Theodore, 1912 .... Butte, Mont.
Mining Engineer, Butte and Superior Mining Co.
Pratt, A. F., 1913 .... Portland, Ore.
Pratt, Paul D., 1905 .... Helena, Mont.
Chief Engineer, State Highway Commission.
Proctor, M. D., 1908 .... Truly, Mont.
McNair & Proctor Ranch Company.
Proctor. I. O., 1908 .... Butte, Mont.
Metallurgical Engineer, Timber Butte Milling Co.
Reardon, D. J., 1907 .... Butte, Mont.
With Reardon & Sons, Contractors and Engineers.
Reber, Bert A., 1915 .... Absarokee, Mont.
Engineer and Superintendent of Construction for Hydro-Electric Plant, Absarokee Power Company.
Reese ,Clara Clark, 1904 .... Long Beach, Cal.
Reid, Milton A., 1913 .... Butte, Mont.
Chief Chemist, Washoe Sampler, A. C. M. Co.
Roach, James, 1911.
Deceased.
Schaefer, W. A., 1907.
Deceased.
Schiffner, O. E., 1908 .... Hornsilver, Nev.
General Manager, Silver Mines Corporation.
Sheedy, John W., 1915 .... Butte, Mont.
Assistant Metallurgist, Butte and Superior Mining Co.
Shields, E. Floyd., 1911 .... Butte, Mont.
Mining Engineer, Butte and Superior Mining Co.
Sparks, Karl T., 1917 .... Butte, Mont.
Mine Rescue Team, West Colusa Mine, A. C. M. Co.
Steele, Chester H., 1916 .... Butte, Mont.
Geologist, A. C. M. Co.
Stevenson, Isabel Little, 1904 .... Richmond, Va.
Stevenson, L. C., 1905.
Deceased.
Stockett, Norman A., 1909 .... Calgary, Alberta, Canada
Student at Engineers' Reserve Training Camp, Camp Lee, Va.
Strang, Willis B., 1916 .... Musselshell, Mont.
Mining Engineer, Star Coal Company.
Stuewe, William, Jr., 1910 .... Porterville, Cal.
Operating, Magnesite.
Sultzer, H. Duke, 1911 .... Butte, Mont.
Assistant Engineer, A. C. M. Co.
Tallant, Harry S., 1904 .... Palma Sola, Fla.
Engaged in farming and fruit growing.

Ternouth, Blaine, 1914........Butte, Mont.
Testing Electrical Engineer, Butte and Superior Mining Co.
Tout, Charles, 1911........
Tseo, G. B., 1917........Kiangse, China
Mining Engineer.
Van Gundy, J. E., 1905........Philipsburg, Mont.
Representative Eastern Smelteries, Manganese Ore Purchaser.
Villars, Jesse R., 1908........Kalma, Mont.
Ranching.
Vivian, George, 1917........Butte, Mont.
Statistician, 316 Engineers, U. S. Army.
Walton, Lee M., 1908........Great Falls, Mont.
Manager, Wardrobe Company.
Warfield, Hershel, 1906........Los Angeles, Cal.
Watson, Robert A., 1915.
Deceased.
Wiegenstein, Henry J., 1909........Butte, Mont.
Transit Man, City Engineer's Office.
Wilkinson, Thomas, 1917........Butte, Mont.
Leasing.
Williams, Paul K., 1912........Kellogg, Idaho
Foreman of Construction, Bunker Hill Smelter.
Wilson, T. Bert, 1906........Goldendale, Wash.
City Engineer; Manager of Garage.
Wong, Samuel C., 1916........Tet-tau-wan, Hupeh, China
Mining Engineer, Tayeh Iron Mines.
Woodworth, Guy T., 1915........Great Falls, Mont.
Private, 361st Ambulance Co., 316 Sanitary Train, U. S. Army.
Wren, A. A., 1908........
Young, Arthur B., 1906........Canille, Ariz.
Mining Engineer, Private Practice.
Young, S. A., 1906........Astoria, Ore.
Mining Engineer, Private Practice.
Young, William A., 1909........Maiden, Mont.
Lessee, Maginnis Mine.
Zentner, Arthur A., 1911........Great Falls, Mont.
Research Engineer, Electrolytic Zinc Plant, A. C. M. Co.

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PUBLICATIONS OF THE UNIVERSITY OF MONTANA

Copies of the several series of the University of Montana Bulletin, of the University of Montana Circular and of the University of Montana Syllabi, may be obtained upon request from the President of the particular institution concerned. Copies of the University of Montana studies and of the general series of the Bulletin and of the Circular will be furnished from the office of the the Chancellor of the University.

I. UNIVERSITY OF MONTANA BULLETIN

Each series of the Bulletin is issued quarterly, and contains annual reports, catalogues, etc.

1. General Series (Office of the Chancellor).
2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
4. Experiment Station Series.
5. Normal College Series.
6. School of Mines Series.
7. Alumni Series.

II. UNIVERSITY OF MONTANA CIRCULAR

Each series of the Circular is issued at irregular intervals and contains various special announcements.

1. General Series (Office of the Chancellor).
2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
4. Experiment Station Series.
5. Normal College Series.
6. School of Mines Series.

III. UNIVERSITY OF MONTANA STUDIES

Issued quarterly, and contains the contributions resulting from the investigation and research in the several departments and divisions of the University, excepting those of the Agricultural Experiment Station, which are issued in the Bulletin.

IV. UNIVERSITY OF MONTANA SYLLABI

Each series contains outlines and Syllabi of certain courses of instruction given at the several institutions.

1. State University Series.
2. College of Agriculture and Mechanic Arts Series.
3. Normal College Series.
4. School of Mines Series.

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UNIVERSITY OF MONTANA BULLETIN

SCHOOL OF MINES SERIES NO. 3

STATE SCHOOL OF MINES

NINETEENTH ANNUAL CATALOGUE

1918-1919

ANNOUNCEMENTS FOR
1919-1920

BUTTE, MONTANA
JULY, 1919

Application made at Butte, Montana, as second class matter under Act of Congress, August 24, 1912.

THE UNIVERSITY OF MONTANA

Edward C. Elliott, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913).

The general control and supervision of the university are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

Montana State Board of Education

S. V. STEWART, Governor	Ex-officio, President
S. C. FORD, Attorney General	Ex-officio
MAY TRUMPER, Superintendent of Public Instruction	Ex-officio, Secretary

LEO H. FAUST	(1919)	JOHN DIETRICH	(1921)
W. H. NYE	(1919)	A. LOUIS STONE	(1921)
W. S. HARTMAN	(1920)	C. H. HALL	(1922)
C. E. K. VIDAL	(1920)	J. B. KREMER	(1922)

The University comprises the following institutions, schools and departments:

The State University, Missoula

Established February 17, 1893, and Consisting of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The School of Education
The School of Business Administration

The Summer Quarter
The Biological Station (Flathead Lake)
The Public Service Division
Special War Courses—
- Military Service Course (one year)
- Nurses' Preparatory Course (one year)
- Office Training Course (one year)

The Graduate Division

Edward O. Sisson, President

The State College of Agriculture and Mechanic Arts, Bozeman

Established February 16, 1893, and Consisting of

The College of Agriculture
The College of Engineering
The College of Applies Science
The College of Household and Industrial Arts
Courses for Vocational Teachers
The School of Music
The Summer Quarter
The Agricultural Experiment Station

The Agricultural Extension Service
The Secondary Schools—
- Home Economics
- Mechanic Arts
- Agriculture

Special War Courses—
- Military Service Course (one year)
- Nurses' Preparatory Course (one year)
- Office Training Course (one year)

James M. Hamilton, President

The State School of Mines, Butte

Established February 17, 1893

The State Bureau of Mines and Metallurgy

Charles H. Bowman, President

The State Normal College, Dillon

Established February 23, 1893, and Consisting of

The Teachers' Certificate Course
The Tthree-years Course
The Four-years Course
The Rural Teachers' Course
The Course for Supervisors

Joseph E. Monroe, President

For publications and detailed information concerning the different school and colleges address the president of the particular institution concerned. Communications intended for the Chancellor of the University should be address to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA BULLETIN

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School Calendar 1919-1920

1919

SUMMER SESSION

June 23, Monday, Summer Session begins.
August 16, Saturday, Summer Session ends.
August 18, Monday, Field Work in Plane Surveying begins.
August 25, Monday, Field Work in Geology begins.
September 13, Saturday, Field Work ends.

FIRST SEMESTER

September 15, Monday, First Semester begins.
October 12, Sunday, Columbus Day.
November 27, Thursday, Thanksgiving Day.
December 20, Friday, Christmas Recess begins.

1920

January 5, Monday, Christmas Recess ends. Instruction begins.
January 30, Friday, First Semester ends.

SECOND SEMESTER

February 2, Monday, Second Semester begins.
February 12, Thursday, Lincoln's Birthday.
February 22, Sunday, Washington's Birthday.
May 30, Sunday, Memorial Day.
June 4, Friday, Commencement Day.
September 13, Monday, First Semester begins.

Official Directory

EXECUTIVE BOARD

CHARLES H. CLAPP (ex-officio) Chairman	Butte
OSCAR ROHN	Butte
RENO H. SALES	Butte

ADMINISTRATIVE OFFICERS

EDWARD C. ELLIOTT, Ph. D.	Chancellor, University of Montana
*CHARLES H. BOWMAN, M S.	President
CHARLES H. CLAPP, Ph. D.	Acting President
CHARLOTTE RUSSELL	Registrar and Librarian

THE FACULTY

Professors

*CHARLES H. BOWMAN	President, Professor of Mathematics M. S., University of Iowa
CHARLES H. CLAPP	Acting President and Professor of Geology and Mineralogy Ph. D., Massachusetts Institute of Technology
GEORGE W. CRAVEN	Professor of Mechanics and Mathematics M. S., Massachusetts Institute of Technology
LESTER J. HARTZELL	Professor of Chemistry E. M., Colorado School of Mines
H. B. PULSIFER	Professor of Metallurgy B. S., Massachusetts Institute of Technology M. S., University of Chicago Ch. E., Armour Institute of Technology
THEODORE SIMONS	Professor of Mining Engineering E. M., and C. E., Royal Polytechnican, Munich, Austria

Assistant Professors

ARTHUR E. ADAMI	Asst. Professor of Mining Engineering E. M., Montana State School of Mines

Instructors

J. A. KIEFFER	Instructor in Mathematics and Physics B. S., Montana State College of Agriculture
JOHN E. NORTON	Instructor in Chemistry and Mineralogy E. M., Montana State School of Mines

Assistant

M. F. HALEY	Assistant in Mill Work

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*On leave of absence for year 1918-1919.

University of Montana

An Act of Congress, approved February 18, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana, in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1, 1916.

State School of Mines

The establishment of the State School of Mines, in Butte, was supervised by a commission appointed in 1895, consisting of F. E. Sargent, John Gillie, W. W. Dixon, J. H. Leyson, and C. W. Goodale. The lands of the School of Mines were used as a basis for the issue of bonds amounting to $120,000.00, and in 1896 the erection of the main building was begun. An additional appropriation of $26,300.00 was made in 1899 for equipment and maintenance. The school actually opened September 11, 1900, and the first class graduated in June, 1903.

The proceeds from the sale of the lands of the School of Mines have gone into a permanent fund, the interest from which, together with the rentals from unsold lands, has provided the school in recent years with most of its ordinary operating and capital expenditures. In 1907, $59,000.00 was appropriated for a new heating plant and mill building, and in 1910, $15,000.00 was appropriated for a gymnasium.

Nathan R. Leonard, Professor of Mathematics, was the first President of the institution. He was succeeded in 1906 by Charles H. Bowman, Professor of Mathematics, who had been connected with the school since its beginning. In 1918, President Bowman was granted a year's leave of absence, and Charles H. Clapp, Professor of Geology and Mineralogy, was appointed Acting President.

PURPOSE AND SCOPE

The School of Mines has strictly confined itself to the preparation of young men for the mining profession, and by so doing has maintained a very high standard in this field. Before the war ninety per cent of its graduates were engaged in engineering work, very largely in Mining Engineering, and moreover many of its graduates hold positions of great responsibility. Although the distinction between a purely vocational school and an engineering college has always been kept clearly in mind, the school has given its students a practical knowledge of mining subjects, as well as a thorough education in theoretical principles. The fundamental subjects for all forms of engineering are given and special emphasis is laid upon the three main branches of mining—geology, mining and milling, and metallurgy.

LOCATION AND SURROUNDINGS

The State School of Mines is located just inside the western city limits of Butte. The site on the southern bench of Big Butte, the extinct volcano which dominates the city, and from which the city takes its name, was donated by certain public spirited citizens. It is easily accessible, since the street cars run within two blocks. The location is most commanding and the view from the grounds overlooks the city, mines, and smelters, as well as the mountains which form the Continental Divide, and which surround the valley in which the city is situated on the east and south.

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city, by the leading financiers and mining men of this country and Europe, have given this locality such publicity that no one needs to be told of its leading position in the mining world.

In Butte are to be found, not only some of the largest copper and zinc mines of the world, but great mills and reduction plants. These are being continually enlarged and improved to meet the demands of greater industry. In addition, Butte is the site of other great engineering enterprises, and in few other places is there such an assemblage of machine shops, factories, and power plants as are to be found in the vicinity of the school. The city is, therefore, especially well fitted to meet the needs of a mining school.

In a very important sense all of these plants are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of the mining and engineering industry and are thoroughly conversant with the details of the work.

BUILDINGS

The main building, erected during 1895 to 1897, is a four-story pressed brick building. It measures one hundred and eighteen feet by ninety-four feet, and contains 37,000 square feet of floor space. In the basement are the chemical, metallurgical, and mechanical testing laboratories. The next two floors contain the recitation rooms, drafting rooms, mineralogy laboratory, and library. The fourth floor is devoted chiefly to museums, which contain extensive collections of minerals, ores, and mine models. In addition, there is also on this floor a petrograph laboratory and a blue print room.

In the rear of the main building is the mill building, completed in 1908. This building measures seventy feet by one hundred and ten feet. It contains the steam and electric power plant which heats the buildings and supplies power to the mill and laboratories. The mill is equipped to handle large quantities of ore conveniently, and affords treatment of ores by most of the standard processes now in practice.

The gymnasium building, to the north of the main building, was erected in 1910. It measures eighty-seven feet by fifty feet and contains a large gymnasium hall seventy feet by forty-five feet. At one end of the gymnasium is a balcony with a seating capacity for one hundred. The hall itself is used on special occasions as a general auditorium. Connected with the gymnasium are two parlors, dressing room, and in the basement are the shower baths.

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of the State. The total sum invested for this purpose now amounts to $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School. The descriptions which follow concern the more important articles that have been procured to illustrate or facilitate the work in the several departments.

Department of Mathematics

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor, abundantly supplied with blackboard space, terrestrial and celestial globes, some simple models, and a blackboard ruled in squares for tracing the graphs of equations and of natural phenomena.

Department of Chemistry

In this, as in all other departments where laboratory work is required, the demand for a large and varied equipment of apparatus and facilities for investigation is great, and the successful prosecution of the purpose for which the technical school is maintained is directly related to the perfection of this equipment. Nearly three-fourths of the entire first floor or basement of the School of Mines has been devoted to the use of this department, together with a lecture room on the second floor. In this space four laboratories have been fitted up, one for qualitative and quantitative analysis, one for metallurgy, and two special laboratories. To these have been added a balance room, a store room for laboratory supplies and a dispensary where the prepared tests for the students in the laboratories are kept.

The laboratories are furnished with working desks of the most approved pattern—each student having his own particular stand—where he is supplied with gas, water, blast, Bunsen burners, a rack for chemical reagents and a cupboard with lock and key, so that he can keep securely the apparatus and material assigned for his use. The laboratories are also supplied with hoods, in which are to be found hot plates, air baths, steam evaporating pans, hydrogen-sulphide apparatus, and a flue with a strong draft to draw off the noxious vapors. The laboratories for qualitative and quantitative analysis and for metallurgy are sufficient for the accommodation of 48 students each.

The students' balance room is provided with six analytical balances for the use of the student in the laboratories. These balances are placed on piers disconnected from the walls and floors of the building so that the vibration is reduced to a minimum.

The special laboratories and preparation rooms are equipped with modern conveniences for carrying on analytical and metallurgical work. In these rooms all the chemical reagents are prepared for the use of the student in the laboratories and all check analysis on the students' work is made. Two dark rooms are provided for photographic work, spectrum analysis, making blue prints and lantern slides.

The chemical lecture room, on the second floor, is provided with a demonstrating table, furnished with pneumatic trough, gas, water, hydrogen and oxygen blast, and direct and alternating currents of electricity up to 750 volts and 45 amperes. The demonstrating table is backed with a hood furnished with the same appurtenances as are provided for the hoods in the laboratories.

Department of Metallurgy

The assay laboratory is situated on the first or basement floor of the building, and is equipped with six of the latest model coal assay furnaces. There are also two gas assay furnaces and gasoline and electric furnaces, which can be used for special work, and a gas retort and melting furnace for melting bullion, making alloys, retorting amalgam, and casting copper..

The pulp room adjoins the assay laboratory, where all charges are weighed and fluxed. Convenient cupboards are provided for storing samples. The silver and gold balances are located in the same room as the analytical balances, and are of the latest approved design.

The crusher room is provided with a Gates crusher, a Low crusher, an Englebach grinder capable of grinding pulp to 80 mesh, a Braun planetary pulverizer, a bucking board, tables upon which to roll samples, and a series of drawers capable of holding 454 twenty-five-pound pulp samples. The supply of assay samples consists of a large number of copper, lead, gold, and silver ores, together with mattes, both copper and lead, slag, flue-dust, calcines, concentrates, tailings, and all smelter products from the copper and lead smelters and other plants of the State.

In the assay laboratory are located separate cyanide outfits for testing ore by the cyanide process. There is also located in this laboratory a calcining furnace capable of being used as a reverberatory or muffle roasting furnace, where large lots can be calcined, or a chlorination roast can be made for hyposulphite treatment.

There are arrangements for treating free milling gold ores by the amalgamation process, as well as cyaniding the tailings from this process.

Gas analysis is at present carried on in the chemical lecture room. There is a very complete set of Hempel's gas apparatus, and analyses are made of gases of combustion, reverbatory and blast furnace and illuminating gases.

A dark room for students' use adjoins the balance room, which contains a large Kirchoff-Bunsen spectroscope and supplementary apparatus for qualitative analytical work in determining the presence of the alkali and alkaline earth metals by their volatilization in the non-luminous flame of the Bunsen burner. The spectroscope is provided with a scale for the determination of the exact location and relative position of the lines of the spectra, or, two spectra may be studied and compared at the same time.

Mining, Ore Dressing, and Metallurgy

A room 24 by 31 feet is provided on the second floor for lectures in the various branches of mining and ore-dressing. The drawing classes occupy three large, well-lighted rooms. Ample table room and individual drawer room are provided throughout; cabinets for filing drawings and drawing-boards are also provided. A large collection of drawings furnished by various manufacturing companies of mining machinery is on hand and is used as an aid to the student in developing new work. The collection of parts of machines is gradually increasing. The material is of great assistance to the department in developing the work in machine design.

For the practical work in surveying the following instruments have been provided: Ten engineering transits; one from Buff & Buff, two from C. L. Berger & Sons, four from Gurley, one from Keuffel & Esser, one from Young & Son, and one from Eugene Dietzgen. Five levels—one from Buff, one from Gurley, two from Keuffel & Esser, one from Berger, and one from Young & Son. One solar compass and one sextant with artificial horizon, from Gurley; two aneroids by Short & Mason (London), and a collection of minor apparatus, including Brunton compass, clinometers, Locke levels, chains, tapes, plumets, shaft plumbing equipment, rods, and flags, necessary in carrying on the work of the department. To this equipment has recently been added by donation a plane table with alidade, a Breithaupt & Sons' level with tripod, and a Tacher's calculating instrument.

A mine model has been constructed in the school shops for use in the lecture room, which greatly facilitates the solving of many of the more complicated problems in mine surveying.

The metallurgical laboratory occupies a building by itself. This building also contains the central heating plant and the engine and dynamo room. The metallurgical laboratory proper occupies a room 70 by 77 feet, half of which is devoted to ore dressing. The ore dressing department consists of a set of storage bins with a capacity of from 80 to 100 tons of ore. One eight-inch by twelve-inch Dodge crusher, two sets of twelve and one-half-inch by twelve-inch rolls, two belt elevators, three trommels thirty inches in diameter and forty-eight inches long, one impact screen for dry screening, a duplex Callow screen for screening to forty and eighty mesh, three Evans and one Hartz jigs, one Huntington mill, one Wilfley table, one Deister-Overstrom concentrator, one Deister concentrator slimer, one four-foot Frue Vanner, and a Dings magnetic separator. There is also a three-stamp mill with amalgamating table. Accessories consist of classifiers, settling tanks, centrifugal, and water pumps.

An equipment for making cyaniding tests provides for leaching ores in five-ton lots. In this plant sands and slimes may be separated, dewatered, and treated separately. There are five vats and two sump tanks, one steel tank provided with air and mechanical agitators. All necessary filters and zinc boxes for making commercial tests are installed for use in this plant.

A pan amalgamation plant consists of a Bruckner chloridizing furnace, a pan amalgamator, and settling tank. All the usual equipment, such as steam, launders, and utensils are at hand for the convenient working of this plant.

The laboratory contains a Wedge furnace designed to be used as a reverbatory or a muffler furnace. This furnace is mechanically rabbled and used in roasting ores in lots of one ton or more. There is also a lead-lined agitation barrel provided for experiments involving this type of apparatus.

During the present year there has been added to the metallurgical section of the building, through the kindness of Mr. R. L. Lloyd, a complete laboratory size Dwight-Lloyd sintering machine, on which tests of several hundred pounds can be made. The roasting and sintering or iron, copper, and lead ores of varying compositions and different fluxing can be carried out on a semi-commercial scale.

The mill is arranged in such a manner that complete tests on a commercial scale can be made on various kinds of ore by shifting the travel of the ore over such machines as are found to be best suited to treat any particular ore.

The laboratory also contains a miniature testing plant consisting of small-sized jigs, Wilfley table, hydraulic classifiers, and automatic feeder, for testing ore in quantities up to four pounds, preliminary to sending the ore through the large mill.

The museum of the school contains a very complete collection of the products from the ore dressing plants at the Butte, Anaconda, and Great Falls smelters. These samples are extensively used in lectures on ore dressing, as they show in a most excellent manner the mechanical changes which a particle of ore undergoes during its travel through the various machines designed to separate the valuable metal from its gangue.

On the tables of the library may be found all the leading American technical magazines, as well as many foreign publications. The library also contains a valuable collection of text-books on all the subjects of civil and mining engineering, the use of which is open to all students upon application to the librarian. The office of the Professor of Mining and Ore Dressing also contains a large collection of catalogues, blue prints, and bulletins from leading manufacturers of mining, milling, and smelting machinery. The school is indebted to these manufacturers for the supply of such catalogues and for the many extra copies which they have kindly furnished for distribution among the students.

Several mine maps, an ideal section of a Butte copper vein, a very attractive section through part of the Boston and Montana concentrator at Great Falls, and a great number of appropriate photographs and drawings decorate the walls of the museum and library; these include views of Montana mining towns, the Washoe smelter at Anaconda, of the Boston and Montana smelter at Great Falls, and of various mines and mills about the State. There is a large drawing to illustrate the method of sampling in use at the Taylor & Brunton Sampling Works (now the Washoe Sampling Works) at Butte, and also several drawings of the coal washery of the Cottonwood Coal Company. Finally there are several diagrams, illustrating the relative production of copper, silver, and gold in Montana and other states.

The various mine models, donated from time to time by leading mining companies of Butte, are exceedingly useful in demonstrating not only the geological features indicated on such models, but also the various phases and methods of shaft sinking, drifting, cross-cutting, and stoping, practiced in the mines represented by said models.

Department of Geology and Mineralogy

The department of geology and mineralogy occupies five rooms and part of four others. On the second floor are the office, the lecture room, and the mineralogical laboratory, with provision in the library for certain maps; and on the third floor are the museums, the petrographic laboratory, dark room, and storage rooms.

The collection of minerals belonging to the department has been subjected to a two-fold division into museum specimens and student specimens. The student hand-specimens are placed in drawers, where they are accessible at all times; the material for laboratory work is kept in a separate cabinet; and the museum collection, which consists of the rarer, larger, and more delicate specimens, are kept under glass.

Of general usefulness in all courses of the department are the storage room, the dark room, the lecture room, and the office. The office is a capacious room fitted with desks and tables for the convenience of officers of the department, with cabinets for various collections and with bookcases for the departmental library. The lecture room is provided with wall maps, blackboards, and suitable desks and chairs. It is thirty-one feet long by twenty-four feet wide. One corner of the room is occupied by a geological relief map of the United States modeled on a section of a globe sixteen feet in diameter. This shows the topography, as well as the areal geology, of the entire country. A map-case five feet square contains the larger geological and areal maps. The dark room on the third floor contains apparatus and chemicals for photographic work. The storage room on the same floor contains materials for exchange.

An extensive collection of crystals is used not only to illustrate the lectures in crystallography but also as material for laboratory exercise. In addition to these real crystals four series of crystal models are available, two of wood, one of celluloid, and one of glass. A reflection goniometer for the accurate measurement of crystal angles is installed in the dark room, while hand goniometers for laboratory work are kept in a case in the mineralogical laboratory.

The main museum occupies the north wing of the third floor of the building in a room thirty feet by sixty feet. Twenty-four large glass cases are devoted to ores, rocks, non-metallic products, specimens illustrating geological structures, and some of the larger fossils. Five cases are devoted to a special collection of minerals from the Butte district. All mineral collections are arranged according to the Dana classifications. A collection of one hundred and sixty gold crystals is kept in one of the cases. The mineral collections in the museum contain more than three thousand specimens. The systematic rock collection contains over fifteen hundred specimens. The museum, in all, contains over ten thousand specimens.

The mine model museum occupies a room thirty feet square in the southwest wing of the third floor of the building. Here are to be found many of the classic mine models used in the protracted mining litigation for which the Butte camp has been noted. These models are of many designs and styles and are of much practical use in illustrating the principles and facts of mining geology.

The mineralogical laboratory is thirty-one feet square and contains six laboratory tables capable of accommodating thirty-six students. Each student is provided with complete apparatus for the rapid determination of minerals by physical and chemical tests. A case in one corner of the laboratory contains the students' reference collection, containing over 300 mineral specimens and varieties, arranged according to Dana. Pycnometers, Westphal balances, Plattner scales, burretes, and miscellaneous laboratory supplies are at hand in another case. A collection of minerals for laboratory determination by the students is kept in a set of drawers in the office. Here also will be found a case of chemical and mineralogical reagents and appliances, a tile-topped table, a hood, and all the apparatus necessary for conducting qualitative and quantitative analysis of minerals and rocks. A Greenough-Leitz binocular microscope is available for the mineralogy laboratory.

The working paleontological collection consists of over two thousand catalogued fossils, systematically arranged in cases in the Museum.

For the work in field geology, the department is equipped with plane tables, allidades, Brunton compasses, clinometers, levels, aneroid barometers, tapes, tally registers, cameras, field glasses, and a complete camping outfit.

In the geological museum is a case containing seventeen petrographic microscopes. Ten of these are of the French type, made by Nachet in Paris; and seven of the German type, made by Leitz at Wetzlar. These microscopes are all provided with the necessary attachments for petrographic work, and the two of them, one Leitz and one Nachet, are of a larger size than the others, and are equipped with accessories for research work. The School owns a fine projection apparatus which is provided with a large petrographic microscope for use in illustrating lectures in petrography.

A specially constructed cabinet in one corner of the museum contains five hundred slides of materials, six hundred thin sections of rocks, and one hundred slides of economic interest. The collection of mineral sections is supplemented by eight additional sets of fifteen more important mineral slides put up in individual boxes and a box containing seventeen slides especially prepared for use with the projection microscope.

The thin sections of rock are nearly all represented by hand specimens in the museum collections already described, so that the student may observe the microscopic character along with his microscopic work. A set of one hundred and four wooden models of crystals of the more important rock-forming minerals is also contained in the thin-section cabinet; while a collection of twenty glass models of rock-forming minerals after Grubenmann occupies a wall case.

The thin-section lathe room contains complete equipment for making thin sections of rocks and minerals, and for polishing opaque minerals. There are two electrically driven lathes in this room; one is provided with two laps for rough and fine grinding, respectively; the other with a diamond wheel for cutting slides, and with two emery wheels for grinding. Emery, Canada balsam, thick glass, slides, covers, and all other supplies and accessories are at hand for use.

A camera for taking photo-micrographs is installed in the dark room.

Department of Mechanics

This department occupies three rooms on the first floor. The lecture room has a seating capacity of forty persons, and is provided with modern lecture room conveniences, such as water, gas, and electric current. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound, and light. The physical laboratory is equipped with heavy tables and apparatus for the measurement of physical constants. The apparatus consists of the usual assortment required in the measurement of density, elasticity, force of gravity, the latent heats of fusion and evaporation, and the mechanical equivalent of heat. There is also a photometer, together with the necessary accessories. For the measurements in electricity, there are provided ammeters, voltmeters, resistance boxes, Wheatstone bridges, galvanometers, batteries, and keys.

An engine and dynamo laboratory is located in the basement of the building; there is installed here a gas engine of ten-horsepower for experimental purposes. A ten-horsepower three-phase induction motor drives direct and alternating current dynamos. A switchboard connects these machines with lines running to various parts of the building, also to motors and a rotary converter, and to a bank of transformers. It is possible to illustrate most of the connections in power transmission system with the apparatus at hand, as well as to perform many interesting tests. A storage battery of ten cells is also connected to the switchboard, so that any number of them may be connected to any of the circuits for lecture or experimental purposes. It is charged from the direct current dynamo or mercury arc rectifier. The requisite voltmeters and ammeters for both alternating and direct curents, and rheostats are provided. The laboratory is also supplied with galvanometers, standard condensers, and resistance boxes, necessary for the most exact and complicated electrical measurements.

The power plant for the mill contains two 80-horsepower boilers, a 75-horsepower high-speed engine belted to a 50 K. W. three-phase generator with switchboard and necessary instruments, and an air compressor with steam cylinders 8-inch by 10-inch, and air cylinders 7½-inch and 13-inch by 10-inch.

In connection with this laboratory there is a small shop equipped with the following metal working machines: One 13-inch screw-cutting lathe; one 16-inch shaper; one 22-inch drill. The tool cabinets are provided with an equipment of bench tools for both metal and wood work. There is also a small blacksmith shop, used for making and repairing tools and for giving such students as may desire it practice in forge work in iron and steel.

In addition to the material mentioned above the testing laboratory has at its disposal a 100,000-pound Olson machine arranged for tensile, compression, and shearing tests. The accessories consist of the following: One compression micrometer especially designed for measuring the compression of stone cubes and other building material; one improved deflection instrument for measuring the deflection of beams subject to load; one Henning's improved micrometer instrument for measuring the compression or elongation of long specimens. The laboratory is also equipped with a cement testing outfit from Fairbanks, Morse & Co. All accessories, such as molds and sieves, are at hand for making a thorough study of this important subject. The apparatus for making a complete indicator and brake test of an engine is provided, also an apparatus for making a study of the heating power of coals.

The Library

Charlotte Russell, Librarian

The library is located on the second floor of the main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers with its alcoves a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others, is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast, and Geodetic Surveys; Reports on Forestry, Forest Reserves, and Irrigation; of the Naval Observatories, Engineering Corps, and Bureau of Mines. Besides these the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the more important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological, and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound and thus furnish in permanent form more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and the periodical issues of other colleges.

ENDOWMENT

The maintenance of the State School of Mines is provided for by the State through biennium appropriations made by the Legislative Assembly. The sum provided for the biennium ending February 28, 1919, was $77,000.00. For the biennium ending February 28, 1921, the appropriation for maintenance is $90,000.00, and for buildings $100,000.00.

EXPENSES OF STUDENTS

FEES AND DEPOSITS

By the Act establishing the School of Mines, no charge of tuition is to be made where the student is a bona fide resident of Montana. Students from other states or counties will pay a tuition fee of $25.00 per semester, or $50.00 a year.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each sudent is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is the list of deposits that are required:

Freshman Year

General Chemistry and Qualitative Analysis	$15.00

Sophomore Year

Plane Surveying	$10.00
Quantitative Analysis	15.00
Mineralogy	5.00

Junior Year

Mine Surveying	$10.00
Assaying	10.00

Senior Year

Metallurgy	$15.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

BOARD AND ROOM

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or its vicinity, and at such places as approved by the faculty. The expense for board and lodging is not higher than in other important cities of the west. Good board can be secured at $30.00 per month, while the cost of a good room large enough for two persons and including light and heat will be from $15.00 to $25.00 per month, according to the location and the furnishings. Cost of text-books average about $25.00 a year. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as found here.

RAILROAD FARE REFUNDS

In accordance with the provisions of Chapter 123 of the Session Laws of 1917, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round-trip between his Montana home and any institution of the University of Montana once each year, will be refunded. No war tax paid by any student will be refunded under any circumstances whatever.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance to the freshman class. This must include at least fifteen units of work. The term unit means one subject pursued for at least thirty-six weeks with not fewer than five recitations per week of forty-five or more minutes each. Two periods of laboratory, shop, or drawing work count the same as one recitation.

Of the fifteen units required, three are required in mathematics, distributed between algebra and plane and solid geometry; three are required in English composition and literature; and one is required in physics.

ADMISSION ON CERTIFICATE

Graduates of the accredited high schools of Montana obtain admission by presenting certificates of principals stating subjects taken, time given for each, and grade obtained.

Blanks for such certificates are furnished by the Registrar. These should be filed in the Registrar's office on or before the first day of registration.

ACCREDITED HIGH SCHOOLS, 1918-1919

District High Schools: Alberton, Anaconda, Baker, Belgrade, Belt, Big Sandy, Billings, Bridger, Broadview, Butte, Chinook, Columbia Falls, Columbus, Conrad, Corvallis, Culbertson, Cutbank, Darby, Fairview, Florence, Forsyth, Fromberg, Glasgow, Great Falls, Hamilton, Hardin, Harlem, Harlowton, Havre, Helena, Hobson, Hysham, Joliet, Jordan, Judith Gap, Laurel, Libby, Malta, Manhattan, Moore, Plains, Plentywood, Polson, Pony, Poplar, Ronan, Rosebud, Roundup, Ryegate, St. Ignatius, Shelby, Sheridan, Sidney, Stanford, Stevensville, Stockett, Terry, Thompson Falls, Three Forks, Valier, Victor, Virginia City, Whitefish, Whitehall, White Sulphur Springs, Worden.

County High Schools: Beaverhead (Dillon); Broadwater (Townsend); Carbon (Red Lodge); Choteau (Fort Benton); Custer (Miles City); Dawson (Glendive); Fergus (Lewistown); Flathead (Kalispell); Gallatin (Bozeman); Granite (Philipsburg); Jefferson (Boulder); Lincoln (Eureka); Missoula (Missoula); Park (Livingston); Powell (Deer Lodge); Sweet Grass (Big Timber); Teton (Chouteau); Wibaux (Wibaux).

Private Schools: Academy of Montana Wesleyan College (Helena); Academy of Mount St. Charles College (Helena); Butte Business College (Butte); Central High School (Butte); Loyola High School (Missoula); Mount Angela Ursuline Academy (Great Falls); Polytechnic Institute (Billings); Sacred Heart Academy (Missoula); St. Vincent's Academy (Helena).

Preparatory work done in other schools than those accredited may receive credit. Applicants from such schools should present certificates stating the same points as those given from accredited schools. Blanks for this purpose are furnished by the Registrar. When the evidence of certificate is not clear and satisfactory, examinations will be given.

Graduates of high schools not in Montana are admitted on certificates without examination if such high schools are accredited to their own state universities.

ADMISSION ON EXAMINATION

Applicants wishing to receive entrance credits on subjects for which they do not present satisfactory certificates are required to take examinations on days prescribed in the calendar. For the academic year 1919-1920 these days are September 17 and January 21.

Those who are preparing to take entrance examinations should correspond with the Registrar for suggestions in regard to such preparation.

CONDITIONAL ADMISSION

The entrance requirement of the completion of a four-years' preparatory course, with at least fifteen units of credit, may be modified in individual cases, by permitting them to enter conditionally if otherwise qualified, if they are entitled to at least thirteen admission units. Students twenty years of age or younger, who have thirteen units may be admitted as conditioned students only upon the specific recommendation of the principal of the high school in which they studied. Entrance conditions must be removed within one year from time of admisson.

ADMISSION OF SPECIAL STUDENTS

Students twenty-one years of age or older, not candidates for degrees, may be admitted without the usual entrance units, as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired.

Special students may acquire status as regular students and become candidates for degrees upon complying with the rules applicable to such cases.

ADMISSION AS "WAR SPECIALS"

All students who have been in the military service may be admitted as "War Specials," regardless of high school graduation, upon the presentation of satisfactory evidence that they can carry the work successfully. "War Specials" may acquire status as regular students and become candidates for degrees, after carrying one full year's work successfully and upon complying with the rules of graduation.

ADMISSION TO ADVANCE STANDING

Students entering from collegiate departments of other colleges and universities must bring certificates of honorable dismissal. Upon presentation of the proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

CREDIT FOR WAR SERVICE

Credits toward the degrees of the college will be granted for definite and measureable attainments of mind resulting from service in the army and navy of the United States. The number of credits allowed for military service will be determined by the instructor in the branch in which application for credits is made, subject to the approval of the committee on military credit and advanced standing. Application for war service credits must be made by the student not later than twelve months after his discharge from service.

REQUIREMENTS FOR GRADUATION

The School confers the degree of Mining Engineer upon those who have completed the course as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

MISCELLANEOUS INFORMATION

SCHOLARSHIP AND CONDUCT

The School of Mines requires all its students to conform to the usual standards of society and law-abiding citizenship, and to manifest a serious purpose by maintaining satisfactory standing in the courses which they undertake. No student will be permitted to continue his connection with the school who shows persistent unwillingness or inability to comply with these requirements.

Prompt attendance is required of all students at the regular class exercises and satisfactory excuses must be rendered to the instructor in charge for all absences from his classes. If the total number of absences, excused or unexcused, in any class exercise amounts to one-fifth of the total number required for the semester, the student may be debarred from further attendance in that class or department of study.

SCHOLARSHIP GRADES

Each student shall receive a final mark at the end of each semester. The passing grade shall be seventy per cent. If a student's grade in any subject shall fall below fifty-five per cent, the grade registered shall be "failed," and the work must be repeated in class. Also, further attendance in that line of study must be discontinued until the passing grade is obtained. In case a student's grade in any subject falls between fifty-five and seventy per cent, he is conditioned in that subject, but may continue and receive credit for the work, provided the condition is removed within a reasonable time after the condition has been incurred.

A student may withdraw from a course in which he has registered during the first two weeks, with the consent of the instructor, registrar, and president. After this time he may withdraw only with the consent of the faculty. All withdrawals must be formal and must be recorded by the student with the registrar.

EMPLOYMENT AND AID FOR STUDENTS

A large number of students of the School of Mines earn either the whole or a part of their expenses while in college. The School cannot guarantee work for students, but under ordinary conditions of mining most of the students find work in the mines for two shifts a week. A few students find work about the school as stenographers and laboratory assistants. During the summer vacations students readily find profitable employment in many occupations, but especially in mining.

HIGH SCHOOL HONOR SCHOLARSHIPS

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana it is the declared policy of the State Board of Education to provide for the awarding of scholarships to be known as "High School Honor Scholarships" to graduates of the accredited high schools of the State.

In the administration of this policy the number of scholarships awarded each year in any accredited high school will depend upon the number of graduates, as hereinafter specified. In no case, however, will more than two such scholarships be awarded each year in any high school for any one of the institutions of the University. High School Honor Scholarships may be awarded only to students who belong to the highest one-fourth of the graduating class in scholarship.

The following general regulations will govern the awarding of High School Honor Scholarships:

1. Upon the presentation of the required certificate from the principal, the Chancellor of the University will authorize the award, each year, to graduates of each of the accredited public high schools of the state, of High School Honor Scholarships for the component institutions of the University of Montana.

2. To be eligible for a High School Honor Scholarship the individual must be certified by the principal:

(a) To be a graduate of an accredited high school of the state;

(b) To belong to the highest one-fourth of his class in scholarship.

(c) To be a student of ability and promise of success in college or professional school; and

(d) To be the highest in scholarship of those members of the graduating class desiring to attend the University institution for which the honor scholarship is to be awarded.

3. No more than one honor scholarship may be awarded to the membership of any graduating class having seven or fewer graduates; no more than two scholarships may be awarded to the membership of any graduating class having eight to eleven graduates; no more than three scholarships may be awarded to the membership of any graduating class having twelve to fifteen graduates; no more than four scholarships may be awarded to the membership of any graduating class having sixteen or more graduates.

4. No more than two High School Honor Scholarships may be awarded each year in any high school for any one of the institutions of the University.

5. The holders of High School Honor Scholarships shall be exempted from the payment of all customary fees except the student activity fees and the special fees in the School of Music. All holders of

High School Honor Scholarships will be expected to make the required course deposits.

6. Any High School Honor Scholarship will become void unless the holder enters one of the institutions of the University within eighteen months after graduation from the high school. The holder of a High School Honor Scholarship must give notice to the Registrar of the institution of his intention to utilize the scholarship not later than September 1st of the year in which he intends to enter the institution.

7. Any High School Honor Scholarship will be valid only as long as the holder is in attendance upon some regular course leading to graduation; provided, however, that no High School Honor Scholarship shall be valid for a period longer than five years.

8. In case any individual to whom has been awarded a High School Honor Scholarship relinquishes the scholarship without entering the institution, or for any reason fails to enter the institution in compliance with Section 6 of these regulations, the high school principal may certify the next ranking eligible member of the same graduating class desiring to enter the praticular institution.

9. The privileges of a High School Honor Scholarship may be retained only so long as the holder maintains a standard in scholarship and regularity of attendance satisfactory to the faculty of the institution at which he is in attendance.

MILITARY SERVICE SCHOLARSHIPS

Upon the proper certification of the president that a student has rendered military or navy service to the nation and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service Scholarship to such student. The holders of such scholarships, throughout the course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

By special action of the State Board of Education the privileges of the Military Service Scholarship are extended to all students of the University of Montana who met the requirements for membership in the Students' Army Training Corps, and all who actually took up work in one of the corps of the University of Montana, but were deprived of induction through the action of the War Department cancelling all inductions which were not complete November 11, 1918.

GENERAL UNIVERSITY STUDENT LOAN FUNDS

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds which are available for students in the junior and senior classes of any of the institutions of the University of Montana who are unable to continue their studies without financial aid and are satisfactorily recommended as to character and scholarship by the dean or director or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loans must be repaid within one year from the time of borrowing or, in exceptional cases, one year after graduation. Loans bear two per cent interest.

Application blanks and a statement of detailed regulations governing these loans may be obtained from the Registrar.

AUXILIARY WORK

WAR ACTIVITIES

Sixty-one students and alumni of the State School of Mines are or have been in the active military service of the United States, and in addition most of the remaining students were members of the Students' Army Training Corps. One of the members of the Students' Army Training Corps, Mr. John R. Svendsen, died from pneumonia and one of the alumni, Mr. Stanley B. Carlisle, died from the same disease in France. One student, Mr. Ernest Anderson, was killed in action.

The members of the faculty assisted in the investigation of war minerals in Montana, co-operating with the United States Geological Survey, United States Bureau of Mines, and War Minerals Investigation Committee. Professor C. H. Clapp investigated in particular the chromite deposits, and Professor Theodore Simons took charge of the manganese investigation in Montana for the Bureau of Mines. He made not only monthly reports on the production of the State, but also more complete reports on mining conditions in the Philipsburg and Butte Districts.

STUDENTS' ARMY TRAINING CORPS

In order to provide the army with officers and technically trained experts the War Department established, on October 1, 1918, in the colleges and universities of the country, a branch of the army known as the Students' Army Training Corps. A unit of the corps was established at the State School of Mines and fifty-seven men were inducted into it. Five more students were elligible and applied for induction, but before their inductions were completed the armistice had been signed and further inductions were suspended. On December 9, 1918, the unit was demobilized.

BUREAU OF MINES AND METALLURGY

The Legislative Assembly of Montana for 1919 (Chapter 161, Page 311), established in the State School of Mines a State Bureau of

Mines and Metallurgy. A fund of $20,000.00, necessary for the maintenance of the bureau, was appropriated for the biennium ending February 28, 1921.

The bureau is organized into four major departments, Administration, Geology, Mining, and Metallurgy and Safety.

The object and duties of the bureau, as specified by law, are as follows:

1. To collect, to compile, and to publish statistics, relative to Montana geology, mining, milling, and metallurgy.
2. To collect typical geological and mineral specimens and samples of products; to collect photographs, models, and drawings of appliances used in mines, mills. and smelters of Montana.
3. To collect a library and a bibliography of literature pertaining to or useful for the progress of geology, mining, milling, and smelting in Montana.
4. To study the geological formations of the State with special reference to their economic mineral resources, both metallic and nonmetallic.
5. To examine the topography and physical features of the State with reference to their practical bearing upon the occupation of the people.
6. To study the mining, milling, and smelting operations carried on in the State, with special reference to their improvement.
7. To prepare and to publish bulletins and reports, with necessary illustrations and maps, which shall embrace both a general and a detailed description of the natural resources and geology, mines, mills, and reduction plants of the State.
8. To make qualitative examinations of rocks and mineral samples.
9. To consider such other scientific and economic problems as in the judgment of the State Board of Education are of value to the people of the State.
10. To communicate special information on Montana geology, mining, and metallurgy.
11. To co-operate with the other departments of the University of Montana, with the State Mine Inspector, and with other departments of the State Government as may be mutually beneficial; and to co-operate with the United States Geological Survey and with the United States Bureau of Mines, in accordance with the regulations of those institutions.

The results of the work of the bureau are published in bulletins and circulars which are distributed free of cost to those requesting them. The bureau has been established primarily for service, and so far as is reasonable all problems and questions relating to the mineral resources or mining and metallurgical industry of the State will receive careful consideration. All samples and letters should be addressed to the State Bureau of Mines and Metallurgy, Butte, Montana.

Organization of Instruction

The State School of Mines offers at present only one course leading to the degree of Mining Engineer. However, courses in metallurgical engineering and mining geology will be offered to the class graduating in 1922 and thereafter.

As now organized the school consists of four major departments, mathematics and mechanics, metallurgy and chemistry, geology and mineralogy, and mining engineering. Mathematics and mechanics are required as fundamental for all forms of engineering, and the other three departments emphasize the three main branches of mining. In addition to the subjects offered in these major departments, classes are given in English composition, economics and law, physics, and Spanish.

COURSES IN MINING ENGINEERING

For the Class of 1922 and Thereafter

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	5
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
Qualitative Analysis:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2 wk.	2
Drawing	3	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	2	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	4
Field Geology	3-wk.	1½
	27	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	2	2
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
	27	16

COURSES IN MINING ENGINEERING

For the Classes of 1919 to 1921

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	3	3
Mineralogy:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	3	1
Plane Surveying, Field Work	4-wk.	2
	28	17

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	3	3
Physics	4	3
Mineralogy:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Topographic Drawing	3	1
	30	16

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mechanics	5	4
Geology:		
Lectures	3	3
Laboratory	3	
Metallurgy	3	2
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2-wk.	2
Drawing	3	
Graphics	3	1
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mechanics and Hydraulics	5	4
Geology:		
Lectures	3	3
Laboratory	3	
Metallurgy	3	4
Assaying	6	
Mining:		
Lectures	2	3
Laboratory	6	
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	2	2
Ore Dressing:		
Lectures	2	3
Design	6	
Economic Geology	5	3
Field Geology	3-wk.	1½
Mechanical Engineering	3	2
	30	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	2	2
Ore Dressing:		
Lectures	2	3
Design	6	
Mining Geology:		
Lectures	5	4
Field Work	3	
Power Transmission	3	2
	30	16

COURSES IN METALLURGICAL ENGINEERING

For the Class of 1922 and Thereafter

FRESHMAN YEAR

First Semester	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	9
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

Second Semester	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
Qualitative Analysis:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitaive Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechaics	4	4
Physics	4	3
Quantitative Analysis:		
Lectures	3	3
Laboratory	3	
Quantitaive Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

First Semester	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy:		
Lectures	3	4
Drawing	6	
Organic and Advanced Chemistry:		
Lectures	2	3
Laboratory	3	
Thermodynamics and Mechanical Engineering	3	2
	30	17

Second Semester	Hrs. of Exer.	Units
Engineering Economics	2	2
Metallurgy	3	2
Assaying	6	2
Industrial Chemistry:		
Lectures	4	5
Laboratory	9	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Chemistry	5	3
Electro-Chemistry	4	3
	29	16

Second Semester	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Chemistry:		
Lectures	3	3
Laboratory	3	
Chemical Engineering:		
Lectures	3	4
Laboratory	3	
	29	16

CHEMISTRY

PROFESSOR, L. J. HARTZELL. INSTRUCTOR, JOHN E. NORTON

General Chemistry: 1 S. Fall. 5 credits. Deposit, $15.00. Freshmen. Lectures, recitations, and laboratory. The object of the course is to develop the underlying principles of the subject as a basis for all subsequent work in the department. The student is drilled on the laws governing chemical phenomena, and is made familiar with the principal characteristics and relations of the elements. The work is illustrated by experiments, conducted either by the instructor or the student. Text: "General Chemistry for Colleges," by Alexander Smith. Mr. Hartzell and Mr. Norton.

Qualitative Analysis: 1 S. Spring. 6 credits. Deposit, $15.00. Freshmen. Prerequisite, General Chemistry. Lectures, recitations, and laboratory. The course is designed to instruct the student in the general scheme for the separation and detection of the metallic elements and the more common acid radicals. Chemical arithmetic or stochiometry is given during the latter part of the course. Text: "Qualitative Analysis," by Prescott and Johnson. Mr. Hartzell and Mr. Norton.

Quantitative Analysis: 2 S. Continuous. 6 credits. Deposit, $15.00. Sophomores. Prerequisite, Qualitative Analysis. Lectures, recitations, and laboratory. The course is designed to meet the needs of the mining engineer, and the object is to develop the student's ability to perform quantitative analysis rapidly and accurately. The problems in the laboratory are selected as far as possible from the work of the practitioner in the smelters and mines of the West. The course emphasizes all the general methods of analysis as applied to limestones; dolomites; ores of iron, mercury, lead, zinc, copper, arsenic, antimony, and tin; rocks; cements; slags, mattes; and water.

The principles of acidimetry and alkalimetry are studied and explained and demonstrated by the analysis of acid and alkaline solutions.

While the practical features of quantitative analysis are emphasized, these are primarily employed to develop the theory and to show the practical application of chemical theory. Mr. Hartzell.

ENGLISH AND ECONOMICS

PROFESSORS, C. H. CLAPP AND THEODORE SIMONS

English Composition: 2 S. Continuous. 4 credits. Freshmen. Lectures and recitations. The purpose of the coure is to enable the student to write and speak clearly, accurately, and easily, especially upon scientific and engineering topics. This is accomplished by a drill in the fundamental principles of all forms of composition. Text: "Principles of Composition," by H. G. Pearson. Mr. Clapp.

Engineering English: 2 S. Continuous. 4 credits. Sophomores. Prerequisite, English Composition. Oral and written exercises in describing and explaining mechanical devices, engineering processes, and scientific principles; followed by the preparation of formal, written and oral reports. Mr. Simons and Mr. Clapp.

Engineering Economics: 2 S. Continuous. 4 Credits. Juniors. Lectures and recitations, elementary economics, sociology, business management, and law as applied to the engineering industry, more particularly the mining industry.

GEOLOGY AND MINERALOGY

PROFESSOR, C. H. CLAPP. INSTRUCTOR, JOHN E. NORTON.

Mineralogy. 2 S. Continuous. 3 credits. Deposit, $5.00. Sophomores. Juniors after 1919. Prerequisite, Qualitative Analysis. Lectures, recitations, laboratory, museum study, and field excursions. The purpose of the course in mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests, and by sight, is the object sought. The course is divided into crystallography, blow pipe analysis, and determinative and descriptive mineralogy. Text, Dana's "Manual of Mineralogy," by W. E. Ford. Mr. Clapp and Mr. Norton.

(This course is not given in 1919-1920.)

Geology: 2 S. Continuous. 6 credits. Juniors. Sophomores after 1919. Prerequisite, Qualitative Analysis. Lectures, laboratory, and field excursions. Physiographic, dynamic, and structural geology are first studied, followed by a brief outline of historical geology and geology of North America. Montana geology is given particular attention. The needs of the mining engineer are kept constantly in mind, and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text, "Textbook of Geology," by Pirsson and Schuchert. Mr. Clapp and Mr. Norton.

Economic Geology: 1 S. Fall. 4 credits. Seniors. Prerequisite, Geology and Mineralogy. Lectures and recitations. A course in the more theoretical aspects of the geology of ore deposits, including structural features, transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and non-metallic, especially those of North America, is gained by the preparation of reports and maps. Text, "Mineral Deposits," by W. Lindgren. Mr. Clapp.

Field Geology: Three weeks' field work. 1½ credits. Seniors. Prerequisite, Geology, Mineralogy, and Plane Surveying. A course in the various methods of geological surveys, including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared, but material for laboratory study is collected and geological reports are written. Mr. Clapp.

Mining Geology: 1 S. Spring. 5 credits. Seniors. Prerequisite, Economic and Field Geology. Lectures, recitations, and field work. Application of geology of ore deposits to practical mining problems, and two weeks of field work in the principles and practice of underground geologic mapping, with the preparation of geological reports on the mines examined. Mr. Clapp.

MATHEMATICS AND MECHANICS

PROFESSOR, GEORGE W. CRAVEN. ASSISTANT PROFESSOR, A. E. ADAMI.

INSTRUCTOR, J. A. KIEFER.

Algebra: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. After a preliminary course, designed to drill the student in the fundamental algebraic operations, and in the statement and solution of simple mechanical problems, those operations of advanced algebra, which will be of use to the student in future engineering courses are carefully studied. Special attention is given to the use and theory of exponents and logarithms, simultaneous quadratic equations, the more common series with their practical applications, in determining coefficients and quantics solved by synthetic division and by graphical methods. Text, "College Algebra," by Wentworth. Mr. Kiefer.

Trigonometry: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. In plane trigonometry the subjects of primary importance are goniometry, solutions of right and oblique triangles, and practical problems. Those considered in spherical trigonometry are the solution of right and oblique spherical triangles, and their development and practical application to surveying and mensuration. Text, "Plane and Spherical Trigonometry," by Wentworth. Mr. Adami.

Analytical Geometry: 1 S. Spring. 3 credits. Freshmen. Prerequisite, Algebra. Lectures and recitations. The material gathered from algebra, geometry, and trigonometry is combined in a manner which leads to a practical knowledge of these branches of mathematics. The student is required to study and plot accurately numerous problems covering such topics as the point and straight line in the plane, different systems of co-ordinates, conic sections, higher plane curves, the point and straight line in space, curved surfaces, and surfaces of revolution. Toward the end of the course the student is required to study various mechanical movements, to devise movements, and to determine the laws and equations involved. Text, "Analytical Geometry," by Wentworth. Mr. Kiefer.

Calculus: 1 S. Fall. 4 credits. Sophomores. Prerequisite. Analytical Geometry. Lectures and recitations. Differential and integral calculus covering the followings subjects: Differentiations, tangents, normals, subtangents, subnormals, asymptotes, indeterminate forms, logarithms, maxima and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text, "Differential and Integral Calculus," by Taylor. Mr. Craven.

Calculus and Analytical Mechanics: 1 S. Spring. 4 credits. Sophomores Prerequisite, Calculus. Lectures and recitations. A continuation of the course in Calculus, and a consideration of the theoretical principles of mechanics. Text, "Differential and Integral Calculus," by Taylor. Mr. Craven.

Mechanics:. 1 S. Fall. 4 credits. Juniors. Prerequisite, Calculus and Analytical Mechanics. Lectures and recitations. In the course in mechanics the laws of elasticity and resistance of materials are studied and applied to the proportioning of pipes, cylinders, and riveted joints. The general theory of beams, including cantilever, continuous, and restrained, is given and the graphical solutions are developed, as well as the analytical. The application to columns or struts is developed and to shafting for transmitting power. Special subjects are taken up which are of interest to the engineer, such as resilience and work, impact and fatigue, true and internal stresses. Many problems are solved, selected from engineering practice, to illustrate the theory developed. The course also includes a study of the properties and uses of various building materials, the metals, timber, stone, brick, and cement.

It is the object of this course to direct the student's attention to the elements of the design of mining machinery. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keys, pipes and pipe fittings, shafting, couplings, and supports for shafts. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, ropes, and gearing. Special attention is given to the installation and maintenance of machinery, and in this connection a great deal of practical information is obtained by frequent visits to the repair shops of the Butte mines. Text, "Mechanics of Materials," by Merriman. Mr. Craven.

Mechanics and Hydraulics: 1 S. Spring. 4 credits. Juniors. Prerequisite, Mechanics. Lectures and recitations. With the conclusion of the course in mechanics, the course in hydraulics is introduced with a brief review of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involving the flow of water through orifices, over weirs, through pipes, flumes, and conduits. Attention is given to the elements of design of dams and adjuncts and to the investigation of the various turbine, impulse wheels, and governing devices. Text, "Treatise on Hydraulics," by Merriman. Mr. Craven.

Physics: 2 S. Continuous. 6 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures, recitations, and laboratory. The purpose of the course in physics is to develop those parts that add directly to the working knowledge of the mining engineer, and to direct the student's attention to a systematic development of the principles of physics. The topics considered are: Concurrent and parallel forces; center of gravity; resistance and work; simple machines; gravity and motion; inertia and rotation; mechanics of fluids; nature and measurement of heat and its application to the steam engine, and to the transmission of energy by means of compressed air; electricity and magnetism; a brief study of light and sound, including a study of optical instruments and of the phenomena met in the study of mineralogy and petrography; the principles and application of electricity to dynamos, motors, transmission of energy, and lighting. Mr. Kiefer.

Mechanical Engineering: 1 S. Fall. 2 credits. Seniors. Prerequisite, Physics and Mechanics and Hydraulics. Lectures, recitations, and excursions. Following a short course in thermodynamics, a systematic study is made of the mechanism of engines, non-condensing, condensing, simple and continuous expansion, foundations, bed plates, steamboiler type, and their setting and management, design and construction of chimneys, and general plans for power houses. Text, "Steam Engines and Boilers," by J. H. Kinearly.

In addition a series of descriptive lectures of pumps and pump details, and the construction and management of mining pumps, is given. Text, "Pumping Machinery," by W. M. Barr. Mr. Craven.

Power Transmission: 1 S. Spring. 2 credits. Seniors. Prerequisite, Physics and Mechanics and Hydraulics. Lectures, recitations, and excursions. The student's attention is directed to the general conditions of power transmission, synchronous and induction motors, current reorganizers, hydraulic development, organization of a power station, line construction, centers of distribution, commercial problems, and measurement of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this field. Text, "Power Transmission," by Bell. Mr. Craven.

Mechanical Drawing and Descriptive Geometry: 2 S. Continuous. 5 credits. Freshmen. Lectures and drawing room. The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. Students are required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to them. It is the aim to guard against the copying of drawings so that the student learns to think and construct for himself. The course includes practice in freehand lettering, and the student is taught the use of water color as applied to engineering drawing. Practice is also given in coloring maps and shading parts of machine drawings. As far as possible the problems in drawings are taken from those met by the mining engineer in practice. The study of descriptive geometry is completed and applied to engineering design. Texts, "Mechanical Drawing" and "Descriptive Geometry," by L. Faunce. Mr. Craven and Mr. Adami.

Graphics: 1 S. Fall, Juniors. Spring, Sophomores. 1 credit. Prerequisites, Mechanical Drawing and Descriptive Geometry. Lectures, recitation, and drawing. The course in graphics is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge, or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind and snow. Analysis is made of single-span trusses of various types with horizontal chords, trusses with inclined chords, and continuous trusses. In these to the wind. Text, "Steel Mill Buildings," by Ketchum. Mr. Craven.

METALLURGY

PROFESSOR, H. B. PULSIFER. ASSISTANT, H. F. HALEY.

General Metallurgy: 1 S. Fall. 2 credits. Juniors. Prerequisite, Quantitative Analysis and Physics. Lectures, recitations, plant inspections, and reports. The course is an introduction to the study of metallurgy. The nature of the metals is considered, with outlines of the principles and practices for the winning of all the common metals. The metallurgical industries have their nature and importance presented, after which those operations and processes common to several metals are studied. The latter part of the course is devoted to study of plant organization, safety, welfare, hygiene, and economics. Students are taken to local plants, have the work explained, and are then required to prepare suitable reports. Mr. Pulsifer.

Metallurgy of Iron and Steel: 1 S. Spring. 2 credits. Juniors. Prerequisite, General Metallurgy. Lectures, recitations, plant inspections, and reports. This course studies the use of the ferrous materials, then takes up the production and properties of pig iron, cast iron, wrought iron, and the various kinds of steel. The making of ingots, the mechanical and heat treatment of steel, the correlation of structure and properties to intended use completes the classroom work. Local foundries are studied and reported upon. Mr. Pulsifer.

Metallurgy of Copper and Lead: 1 S. Fall. 6 credits. Deposit, $15.00. Seniors. Prerequisite, Metallurgy of Iron and Steel. Lectures, recitations, laboratory, plant study, and reports. In the classroom a systematic and complete study is made of the metals copper and lead. Properties, methods of winning, and uses are adequately presented. Plants are studied, often several consecutive days, and reports prepared. In the mill building ores are concentrated and the metals actually won by operations on a suitable scale. Mr. Pulsifer and Mr. Haley.

Metallurgy of Zinc, Gold, and Minor Metals: 1 S. Spring. Deposit, $15.00. Seniors. Prerequisite, Metallurgy of Copper and Lead. Lectures, recitations, laboratory, plant study, and reports. In the lecture room the instructor completes the study of metallurgy by presenting the scientific and industrial aspects regarding zinc, gold, aluminum, nickel, and tungsten. Hydrometallurgy and electrometallurgy are systematically reviewed. In the metallurgical laboratory recovery of metals is pursued so that the student gets familiar with equipment, furnaces, pyrometers, and amounts recovered. More plants are studied and described in writing. To get familiar with library work each student prepares an essay on some assigned topic. Mr. Pulsifer and Mr. Haley.

Assaying: 1 S. Spring. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Quantitative Chemistry. Lectures and laboratory. The study of assaying is approached from both the theoretical and practical sides. The course is intended to increase the proficiency of the student in thinking, in knowledge, and in manipulative skill. A great variety of ores, furnace products, and metals are worked upon in the laboratory by several of the best methods. Text, "Notes on Assaying," by Lodge. Mr. Pulsifer and Mr. Haley.

MINING ENGINEERING AND SURVEYING

PROFESSOR, THEODORE SIMONS. ASSISTANT PROFESSOR, A. E. ADAMI.

Plane Surveying: 1 S. Spring. 3 credits. Freshmen. Prerequisite, Algebra and Trigonometry. Lectures and recitations. The course in the theory of plane surveying takes up the construction, adjustment, use, and care of surveying instruments, the form of field notes for different methods of surveying, computation of bearings, co-ordinates, elevations, areas, and quantities of material, from data secured in the field, the solution of problems in surveying, and practical uses of surveying instruments on the school grounds. Text, "Plane Surveying," by Tracy. Mr. Adami.

Plane Surveying, Field Work: Summer Field Work, 4 weeks. 2 credits. Deposit, $10.00. Sophomores. Prerequisite, Plane Surveying. During the course in plane surveying the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets; determination of true meridian by solar observation and by observation on Polaris; traverse survey with transit and steel tape; angles by repetition; azimuth and deflection; problems in public land surveying in accordance with Manual Instruction to United States Deputy Surveyors; official survey of mining claims and application for United States patent; returns to consist of letters of transmittal, plat, field notes, and computations, in form of transmission to United States Surveyor General; topographic survey with transit and steel tape; stadia and trigonometric survey; base line triangulation; leveling for profile and contour lines, and for establishment of bench marks; staking out buildings and excavations for foundations, and calculations of quantities to be excavated; survey of ditch or flume line; preliminary and location survey of railroad. Mr. Adami.

Topographic Drawing: 1 S. Fall. 2 credits. Sophomores. Prerequisite, Plane Surveying, field work. The work consists of platting on a suitable scale the surveys executed in the field. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps, and mills. Additional instruction is given in the construction of contour lines and in the laying out of railroads and wagon roads, dams, reservoirs, flumes, and ditches on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, by cross sections made from contour maps. During the work special attention is given to lettering, titles, borders, and north points, and general neatness in execution. Mr. Adami.

Mine Surveying: 1 S. Spring. 1 credit. Sophomores. Prerequisites, Plane Surveying and Topographical Drawing. A course of lectures on underground surveying and shaft plumbing, including the mathematical and graphical solution of numerous surveying problems. Mr. Simons.

Mine Surveying, Field Work, and Drawing: Summer Field Work, 2 weeks. 1 S. Fall. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Mine Surveying. During the course in Mine Surveying, carried on at a mine in actual operation, the students are required to execute the following surveys and prepare the necessary field notes: Plumbing the shaft; a complete survey of the underground workings, as well as all important surface features, such as buildings, ore bins, tracks, claim boundaries, and streets. In the class room all necessary calculations are made for the final plotting of the field notes and a composite map is made showing the underground workings, surface plant, claim lines, and city streets. In addition a number of sections are made showing the occurrence of the ore bodies, position of shafts, levels, cross-cuts, stopes, and the vertical relation of the ore bodies to the underground workings. Mr. Simons.

Mining: 2 S. Continuous. 5 credits. Juniors. Prerequisite, Mine Surveying. Lectures, drawing, and laboratory. The course in mining takes up the following topics: prospecting, discovery, locating, and acquiring title to mining claims, breaking ground by various methods of hand work, rotary and precussion drills, explosives and their uses, supporting excavations by timbering, masonry, and metallic supports. The lectures and recitations are illustrated by drawings, prints, models, and frequent visits to the local mines. While at the mines special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drills, and boring by precussion drills. In the laboratory actual tests on various kinds of drills are given, with a view to determine the air consumption, rate of drilling, efficiency, and cost of operation. In the drawing room the students are taught to make drawings of structures in wood, masonry, and metal, including ore and coal bins, railroad trestles, headframes, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems, with all conditions and requirements, are dictated to the students and numerous blueprints of actual constructions are on file for reference. Mr. Adami.

Mining: 2 S. Continuous. 4 credits. Seniors. Prerequisite, Junior Mining. Lectures and design. A course in air compression, prospecting for placer deposits, exploitation of gold placers by various methods, including hydraulicking and dredging, water supply for hydraulic and other mining operations, reservoirs, dams, ditches, and pipe lines, exploitation of useful minerals by open work and various methods of underground stoping, mine haulage, hoisting, and hoisting machinery and accessories, drainage and pumping, ventilation, natural and artificial, lighting and sanitary arrangements, commercial mining operations, superintendency and management of mines, selecting and buying samples and machinery, mine economics and mine accounts, examination and reporting on mines and mining enterprises. Mr. Simons.

Ore Dressing: 2 S. Continuous. 8 credits. Seniors. Prerequisite, Mechanics. Lectures, design, and laboratory. A study of the physical laws governing the various processes of ore dressing, such as crushing, jigging, free and hindered settling, the principles of screen sizing and hydraulic classification, the construction and operation of typical milling machinery, rolls, grinding mills, jigs, tables, vanners, magnetic separators, flotation processes, and mill accessories, power transmission and water supply for milling operations. The study of design and methods of ore dressing is further carried on at plants visited during the school year and by practical tests in the ore dressing department of the school laboratory. From the design of single structures, the course leads to the design of a complete plant for one or more operations of mining and ore dressing. It is the aim in this course to develop the originality of the student; although the instructor in charge is always on hand to assist, the student is on his own resources as far as possible. He is required to make use of catalogs and reference books to obtain the data necessary for the completion of his problem. Attention is given to the assembling, bills of materials, and the item of costs. The problems are given to the student and discussed in the classroom.

The course in mining and ore dressing is completed by a two weeks' excursion to districts where mining and ore dressing methods can be studied which do not prevail in the Butte district. Mr. Simons.

SPANISH

Elementary Spanish: 2 S. Continuous. 6 credits. Elective. Open to all students. Texts, "Spanish Grammar," by Espinosah and Allen, and "Lecturas Faciles," by Wilkons.

Register of Students
1918-1919

SENIOR CLASS

Milkwick, Clifford F	Anaconda
Pierce, Wilbur C	Buhl, Idaho
Thrasher, Willard	Butte

S. A. T. C. Members

Courtney, Edward F	Philipsburg
Engel, A. L	Butte
Loughran, David L	Butte
Newton, Claude O	Butte

JUNIOR CLASS

Amberson, Julius M	Mandan, N. D.
Hale, Emmet	Butte
Mueller, Ernest	Butte

S. A. T. C. Members

DeMordaunt, Paul	Butte
Emery, Lawrence W	Butte
Molyneux, Guy M	Butte
Renouard, Edw. I., Jr	Butte
Rowe, Francis A	Butte
Werelius, Walter	Butte
Weir, J. Stanley	Valentine
Wilson, Curtis L	Anaconda

SOPHOMORE CLASS

Feeney, Walter J	Butte
Girshowsky, Boris D	Samara City, Russia
O'Brien, Wallace	Butte
Ponish, Frederick H	Inssbruck, Tyrol, Austria
Shanley, Alice Bernedette	Butte

S. A. T. C. Members

Davey, Ross C	Butte
deCelles, Arthur E	Boulder
Dixon, Charlie B	Butte
Eaves, Lucian, Jr	Butte
Fisher, Samuel H	Butte
Holland, John G., Jr	Butte

McGonigle, Walter S.	Butte
Merrill, William L.	Butte
Murphy, Pat	Butte
Shenon, Philip	Salmon, Idaho

FRESHMAN CLASS

Bigelow, Frank O.	Butte
Bishop, Lester F.	Butte
Byrne, Robert H.	Butte
Franz, Carl	Butte
Gilmore, John J.	Butte
Groom, Carl M.	Butte
Kitto, Cyrus L.	Butte
Lowe, Joe	Logan, Utah
McDonald, Alex	Butte
McMaster, Patrick D.	Butte
McQuay, Ray	Butte
Moldstad, Eiliff F.	Butte
Mowbray, Willard W.	Anaconda
Murphy, William	Butte
Shea, Edward P.	Butte
Simons, Lindsay E.	Butte
Swanson, Arthur	Butte
Tower, William B.	Butte

S. A. T. C. Members

Adelstein, Benjamin	Butte
Anderson, Frank A., Jr.	Butte
Baker, Thomas D.	Butte
Bartzen, Fred C.	Butte
Benedict, Platt C.	Butte
Bowlby, Robert H.	Spearfish, S. D.
Callow, Merton E.	Butte
Carlsen, Alvin	Lewistown
Carroll, Walker E.	Butte
Driscoll, Timothy D.	Butte
Eastman, Charles V.	Anaconda
Fagan, Thomas B.	Butte
Howard, George W.	Butte
Hurlburt, Charles	Thompson Falls
Jacobson, Albert C.	Anaconda
Johnson, Montz E.	Butte
Juul, Bernard F.	Anaconda
McCormick, William	Edwards
McLellan, Donald D.	Butte
Marta, Adolph M.	Butte

Naughten, James J.	Butte
Nuckols, John A.	Anaconda
Rodder, Abe L.	Livingston
Sarles, Henry U.	Butte
Shepard, John H.	Butte
Slatalla, Alex. J.	Great Falls
Svendsen, John B.	Winnifred
Tindera, Stephen	Anaconda
Wade, Ralph J.	Butte

SPECIAL STUDENTS

Lydon, E. L.	Butte
McDonald, Grover	Butte
Maxwell, John J.	Portland, Ore.
Sutton, S. W.	Independence, Kansas

S. A. T. C. Members

Howarth, Vard O.	Park City, Utah
Huie, Quong Pock	Butte
Laslovich, Andrew	Anaconda
Ozanne, Paul	Butte
Schubert, Carl Otto	Butte
Walker, Marshall E.	Seattle, Washington
Voyer, Thomas K.	Anaconda

POST-GRADUATE

S. A. T. C. Member

Walton, Lee M.	Great Falls

Summary of Registration

Seniors	7
Juniors	11
Sophomores	15
Freshmen	47
Special Students	11
Post-Graduate Students	1
Total	92
Students' Army Training Corps	59

Register of Alumni

Adami, Arthur E., 1907..........Butte, Montana
Asst. Professor Mining Engineering, Montana State School of Mines.
Mining Engineer, Montana State Bureau of Mines.
Aline, Peter A., 1915..........Great Falls, Montana
Chemist, B. & M. Reduction Dept., A. C. M. Co.
Andrew, John T., 1912..........Butte, Montana
Lawyer, Maloney & Andrew.
Archibald, George B., 1905..........Salt Lake, Utah
Mineral Examiner, U. S. General Land Office.
Balmforth, Alfred J., 1904.
Bassett, Arthur F., 1912..........New York City
Engineer, General Applications Dept., Hyatt Roller Bearing Co.
Bender, Louis V., 1903..........Anaconda, Montana
General Supt. Washoe Reduction Works, A. C. M. Co.
Bovett, C. A., 1907.
Bowden, Malcolm, 1908..........Butte, Montana
Efficiency Engineer Elm Orlu Mining Co.
Brinton, Owen F., 1905..........Wendover, Utah
General Manager, Western Utah Copper Co.
Brulo, William, 1909..........Helena, Montana
Land Examiner for Montana.
Cannon, Frank D., 1917..........Bordeaux, France
Sergeant in Engineers; studying at Bordeaux University.
Carlisle, Stanley B., 1917.
Deceased.
Cheung, T. C., 1917..........Hong Kong, China
Coal mining.
Christian, O. B., 1912..........Butte, Montana
Draftsman, A. C. M. Co.
Clinch, R. S., 1911..........Moctezuma, Sonora, Mex.
Engineering and Ore Buying Agency.
Clinch, Walter D., 1912..........Butte, Montana
Shift Boss, Timber Butte Milling Co.
Cohan, Jesse E., 1912..........Butte, Montana
Cole, Robert J., 1914..........Butte, Montana
Geologist, Elm Orlu Mining Co.
Collins, Thomas F., 1917..........Butte, Montana
Sampler Bell Mine, A. C. M. Co.
Cooke, Hamilton, Jr., 1912..........Butte, Montana
With Timber Butte Milling Co.
Corey, Clarence R., 1905..........Seattle, Washington
Assistant Professor of Metallurgy, College of Mines, University of Washington.
Crittenden, Zar T., 1913..........Las Pas, Manitoba, Canada
Crittenden & Cullity, Exploration work for Flin Flon Syndicate.
Cullity, Emmet R., 1912..........La Pas, Manitoba, Canada
Crittenden & Cullity, Exploration work for Flin Flon Syndicate.
Curran, Francis R., 1916..........Butte, Montana
Sampler, Elm Orlu Mining Co.

Dobson, Chris G., 1913........A. E. F.
Company B, 23rd Engineers, U. S. Army.
Dugan, John F., 1906........Butte, Montana
Foreman, Nettie Mine, A. C. M. Co.
Duling, J. F., 1904........American E. F.
Captain, Engineers, U. S. R.
Duthie, John M., 1905........American E. F.
Captain, C. of E., Commanding Co. A, 601 Engineers.
Elford, B. E., 1905........Anaconda, Montana
Laboratory, Washoe Reduction Works, A. C. M. Co.
Ellis, Willis H., 1908........Butte, Montana
City Engineer of Butte.

Evans, James R., 1909........Tshikapa, Congo Belge, West Africa
Mining Engineer with Societe Internationale Forestiere et Minere du Congo.
Feeney, Charles M., 1906.
Deceased.
Foote, Frank A., 1908........Kasai, Tshikapa, Congo Belge, West Africa
Mining Engineer.

Fowler, George M., 1912........Butte, Montana
Supt. Northern Montana Natural Gas Co., Butte, Montana.
Geologist, A. C. M. Co.

Gidel, Murl H., 1912........Butte, Montana
Geologist, A. C. M. Co.

Gieser, H. S., 1906........Anaconda, Montana
Concentrating Engineer, A. C. M. Co.
Gilham, Ralph, 1909........Townsend, Montana
Giovanetti, Ettore, 1912........Butte, Montana
Instructor, Butte Business College.

Goodell, Luther T., 1915........Seattle, Washington
Pressman, Seattle Times.
Grunert, August, 1910........Garnet, Montana
Asst. Superintendent with Ludwig S. Mussicbrod.
Grupe, Charles W., 1912.
Haines, Peter A., 1909........Rivermines, Missouri
Division Superintendent, Doe Run Lead Company.
Hanson, Wilbur W., 1913........Butte, Montana
Mining Engineer, A. C. M. Co.
Hill, W. J., 1916........Ray, Arizona
Mining Engineer, Ray Consolidated Copper Co.
Hogan, Eugene, 1916.
Hunt, John E., 1915........Butte, Montana
Testing Engineer, Timber Butte Milling Co.
Ireland, Arthur J., 1904.
Deceased.
Jensen, Walter H., 1910........Great Falls, Montana
Secretary-Treasurer, Montana Brewing Co.
Johns, John W., 1906........Marysville, Montana
Mine Superintendent, Shannon Mine, Barnes-King Dev. Co.
Johnstone, J. Clark, 1909........Nelson, B. C., Canada
Private Practice, Geary & Johnstone.
Kane, Edward G., 1909........Butte, Montana
Foreman, Bell-Diamond Mine, A. C. M. Co.
Kane, L. M., 1906.
Deceased.
Ketcham, S. H., 1908........Missoula, Montana
Private Engineering practice.

Kirby, Kenneth P., 1909........Butte, Montana
  Mining Engineer, Anaconda Mine, A. C. M. Co.
Kuphal, Henry E., 1904.
Lind, A. Leslie, 1916........American E. F.
  First Battery, Co. B, 23rd Engineers, U. S. A.
Ling, Tao, 1917........Toungas, Burma, India
  Mining Engineer, Zacchrens Stone Quarries.
Lomas, E. Percy, 1908........Butte, Montana
  President Butte East Slope Mining Co.
Loughran, David L., 1918........Butte, Montana
  Sampler, Davis-Daly Copper Co.
Lowry, T. M., Jr., 1908........American E. F.
  Company B, 319th Engineers, U. S. A.
Lyden, Joseph P., 1914........Butte, Montana
  Assistant Geologist, A. C. M. Co.
Lyon, Thomas T., Jr., 1916........Butte, Montana
  Geologist, A. C. M. Co.
McCool, Edward J., 1913........Butte, Montana
  Mining Engineer, A. C. M. Co.
McCracken, R. H., 1907........Philipsburg, Montana
  Engineer, Philipsburg Mining Co.
McElvenny, L. T., 1911........Butte, Montana
  Engineer, City Engineer's Office, Butte.
McGee, John, 1904........Tonopah, Nevada
  General Manager, Great Western Con. Mining Co.
  General Manager Greenwater Copper Mines and Smelter Co.
  General Manager, Tonopah Bonanza Mining Co.
  General Manager, Water Company of Tonopah.
McLaughlin, William D., 1908........Butte, Montana
  Mining Engineer, Tramway Mine, A. C. M. Co.
McMahon, Brandon P., 1914........Butte, Montana
  Surveyor, Steward Mine, A. C. M. Co.
Mackel, Louis C., 1905........Phoenix, Arizona
  Mineral Examiner, Field Division, General Land Office, Santa Fe, New Mexico.
MacPherson, Frank H., 1914........Butte, Montana
  Mining Engineer, A. C. M. Co.
MacRae, L. D., 1904........Nacozari, Sonora, Mexico
  Engineer, Moctezuma Copper Co.
Malloy, Emmet E., 1909........Butte, Montana
  State Land Examiner.
Manwaring, J. H., 1913........Butte, Montana
  Mining Engineer, private practice.
Mason, Veyne V., 1917........American E. F.
  Company B., 23rd Engineers.
Meiklejohn, Archie B., 1908........Lost Angeles, California
  Distribution Accountant, Southern California Edison Co.
Murphy, James K., 1911........Anaconda, Montana
  Asst. Superintendent, Washoe Reduction Works, A. C. M. Co.
Murphy, Joseph G., 1914.
Nelson, A. S., 1918........Allenby, B. C., Canada
  Installing concentrating machinery, British Columbia Copper Company.
Newton, Lucian, 1913........Silver Star, Montana
  Leasing, Green-Campbell Mine.
Norton, John E., 1917........Butte, Montana
  Instructor, Chemistry and Mineralogy, Mont. School of Mines.

O'Brien, Albert, 1908..........Butte, Montana
Mining Engineer, private practice.
O'Connor, Charles H., 1911..........Butte, Montana
Testing Department, Timber Butte Mill.
Parker, W. Howard, 1917.
Deceased.
Patten, Earl B., 1908..........Philipsburg, Montana
Mining Engineer, private practice.
County Surveyor, Granite County, Montana.
Pauly, P. L., 1904..........Butte, Montana
Draftsman, Timber Butte Milling Co.
Peter, Ira B., 1909..........Butte, Montana
Mining Engineer, A. C. M. Co.
Peterson, Peter E., 1911..........Anyox, B. C., Canada
Supt. of Concentration, Granby Consolidated Mining, Smelting, and Power Co.
Petritz, William E., 1918..........Butte, Montana
Pierse, Edwin A., 1913..........Great Falls, Montana
Auto Sales Room.
Pilger, Theodore, 1912..........Seattle, Washington
Mining Engineer.
Pratt, A. F., 1913..........Portland, Oregon
Pratt, Paul D., 1905..........Helena, Montana
Chief Engineer, State Highway Commission.
Proctor, M. D., 1908..........Truly, Montana
McNair & Proctor Ranch Co.
Proctor, I. O., 1908..........Butte, Montana
Metallurgical Engineer, Timber Butte Milling Co.
Reardon, D. J., 1907..........Butte, Montana
Contracting Engineer.
Reber, Bert A., 1915..........Neihart, Montana
Mining Engineer and Flotation Operator, Cascade Silver Mines and Mills Co.
Reese, Clara Clark, 1904..........Long Beach, California
Reid, Milton A., 1913..........Butte, Montana
Chief Chemist, Washoe Sampler, A. C. M. Co.
Roach, James, 1911.
Deceased.
Schaefer, W. A., 1907.
Deceased.
Schiffner, O. E., 1908..........Nina, Nevada
General Superintendent, Simon Lead Mines Co.
Sheedy, John W., 1915..........Butte, Montana
Asst. Metallurgist, Butte & Superior Mining Co.
Shields, E. Floyd, 1911..........Butte, Montana
Mining Engineer, Butte & Superior Mining Co.
Sparks, Karl T., 1917..........Butte, Montana
With Rescue Car No. 5, U. S. Bureau of Mines.
Steele, Chester H., 1916..........Butte, Montana
Geologist, A. C. M. Co.
Stevenson, Isabel Little, 1904..........Richmond, Virginia
Bookkeeper, Discount Department, Federal Reserve Bank.
Stevenson, L. C., 1905.
Deceased.
Stockett, Norman A., 1909..........Bonne Terre, Missouri
Engineering Dept., St. Joseph Lead Co.
Strang, Willis B., 1916..........Musselshell, Montana
Mining Engineer, Star Coal Co.

Stuewe, William, Jr., 1910........Portland, Oregon
Mining Engineer.
Sultzer, H. Duke, 1911........Butte, Montana
Mining Engineer, A. C. M. Co.
Tallant, Harry S., 1904........Palma Sola, Florida
Farmer.
Ternouth, Blaine, 1914.
Tout, Charles, 1911........Basin, Montana
Supt. Comet Mine, Montana Consolidated Copper Co.
Tseo, G. B., 1917........Nanchong, Kiangse, China
Mining Director of the Industrial & Mining Bureau of Kiangse.
Van Gundy, J. E., 1905........Philipsburg, Montana
Mining Engineer.
Villars, Jesse R., 1908........Kalma, Montana
Ranching.
Vivian, George, 1917........Butte, Montana
Walton, Lee M., 1908........Great Falls, Montana
Manager, Wardrobe Company.
Warfield, Hershel, 1906........Los Angeles, California
In charge of the Financing of Kaibab Smelting Co., Fredonia, Arizona.
Watson, Robert M., 1908.
Deceased.
Wiegenstein, Henry J., 1909........Butte, Montana
Mining Engineer.
Wilkinson, Thomas, 1917........Butte, Montana
Asst. Foreman, Reins Mine, A. C. M. Co.
Williams, Paul K., 1912........Anaconda, Montana
Wilson, T. Bert, 1906........Goldendale, Washington
Manager, Goldendale Garage.
Wong, Samuel C., 1916........Tet-tau-wan, Hupeh, China
Mining Engineer, Tayeh Iron Mines.
Woodworth, Guy T., 1915........American E. F.
Corporal, 316 Sanitary Train, 361 Ambulance Co.
Wren, Andrew Addison, 1908........Ray, Arizona
General Manager, Arizona Hercules Cop. Co.
Young, Arthur B., 1906........Canille, Arizona
Mining Engineer.
Young, S. A., 1906........Astoria, Oregon
Metal Mining Engineer, U. S. Government.
Young, William A., 1909........Maiden, Montana
Lessee, Maginnis Mine.
Zentner, Arthur A., 1911........Great Falls, Montana
Research Engineer, Zinc Plant, A. C. N. Co.

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PUBLICATIONS *of* THE UNIVERSITY *of* MONTANA

Copies of the several series of the University of Montana Bulletin, of the University of Montana Circular, and of the University of Montana Syllabi, may be obtained upon request from the president of the particular institution concerned. Copies of the University of Montana studies and of the general series of the Bulletin and of the Circular will be furnished from the office of the chancellor of the university.

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Each series of the Bulletin is issued quarterly, and contains annual reports, catalogues, etc.

1. General Series (Office of the Chancellor).
2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
4. Experiment Station Series.
5. Normal College Series.
6. School of Mines Series.
7. Alumni Series.

II. UNIVERSITY OF MONTANA CIRCULAR

Each series of the Circular is issued at irregular intervals and contains various special announcements.

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2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
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Issued quarterly, and contains the contributions resulting from the investigation and research in the several departments and divisions Station, which are issued in the Bulletin. of the University excepting those of the Agricultural Experiment

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Each series contains outlines and Syllabi of certain courses of instruction given at the several institutions.

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2. College of Agriculture and Mechanic Arts Series.
3. Normal College Series.
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Each series deals with topics of current importance regarding the affairs of the university and its several institutions.

1. University of Montana Series.
2. State University Series.
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SCHOOL OF MINES SERIES NO. 4

STATE SCHOOL OF MINES

TWENTIETH
ANNUAL CATALOGUE

1919-1920

ANNOUNCEMENTS FOR
1920-1921

BUTTE, MONTANA
JULY, 1920

Application made at Butte, Montana, as second class matter, under Act of Congress. August 24, 1912.

THE UNIVERSITY OF MONTANA

Edward C. Elliott, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913).

The general control and supervision of the university are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

Montana State Board of Education

S. V. STEWART, Governor - - - - - - - - - - - - - - - Ex-officio, President
S. C. FORD, Attorney General - - - - - - - - - - - - - - Ex-officio
MAY TRUMPER, Superintendent of Public Instruction - - - - Ex-officio, Secretary

W. S. HARTMAN	(1920)	J. B. KREMER	(1922)
JOHN DIETRICH	(1921)	LEO H. FAUST	(1923)
A. LOUIS STONE	(1921)	W. H. NYE	(1923)
C. H. HALL	(1922)	WM. M. BOLE	(1923)

The University comprises the following institutions, schools and departments:

The State University, Missoula

Established February 17, 1893, and Consisting of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The School of Education
The School of Business Administration
The Summer Quarter
The Biological Station (Flathead Lake)
The Public Service Division
Special War Courses—
  Military Service Course (one year)
  Nurses' Preparatory Course (one year)
  Office Training Course (one year)
The Graduate Division

Edward O. Sisson, President

The State College of Agriculture and Mechanic Arts, Bozeman

The College of Agriculture
The College of Engineering
The College of Applied Science
The College of Household and Industrial Arts
Courses for Vocational Teachers
The School of Music
The Summer Quarter
The Agricultural Experiment Station
The Agricultural Extension Service
The Secondary Schools—
  Home Economics
  Mechanic Arts
  Agriculture
Special War Courses—
  Military Service Course (one year)
  Nurses' Preparatory Course (one year)
  Office Training Course (one year)

Alfred Atkinson, President

The State School of Mines, Butte

Established February 17, 1893

The State Bureau of Mines and Metallurgy

Charles H. Clapp, President

The State Normal College, Dillon

Established February 23, 1893, and Consisting of

The Teachers' Certificate Course
The Three-Year Course
The Course for Supervisors
The Four-Year Course
The Rural Teachers' Course

Sheldon L. Davis, President

For publications and detailed information concerning the different schools and colleges address the president of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA BULLETIN

SCHOOL OF MINES SERIES NO. 4

STATE SCHOOL OF MINES

TWENTIETH ANNUAL CATALOGUE

1919-1920

ANNOUNCEMENTS FOR
1920-1921

BUTTE, MONTANA
JULY, 1920

Application made at Butte, Montana, as second class matter, under Act of Congress.
August 24, 1912.

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School Calendar 1920-1921

1920

SUMMER WORK

June 7, Monday, Mine Surveying begins.
June 18, Mine Surveying ends.
August 16, Monday, Field Work in Plane Surveying begins.
August 23, Monday, Field Work in Geology begins.
September 11, Saturday, Field Work ends.

FIRST SEMESTER

September 15, Monday, First Semester begins.
October 12, Tuesday, Columbus Day, holiday.
November 25, Thursday, Thanksgiving Day, holiday.
December 18, Saturday, Christmas Recess begins.

1921

January 3, Monday, Christmas Recess ends. Instruction begins.
January 28, Friday, First Semester ends.

SECOND SEMESTER

January 31, Monday, Second Semester begins.
February 12, Saturday, Lincoln's Birthday.
February 22, Tuesday, Washington's Birthday, holiday.
May 30, Tuesday, Memorial Day, holiday.
June 2, Friday, Commencement Day.
September 16, Monday, First Semester begins.

Official Directory

EXECUTIVE BOARD

CHARLES H. CLAPP (ex-officio) Chairman - - - - - - - - Butte
OSCAR ROHN - - - - - - - - - - - - - - Butte
RENO H. SALES - - - - - - - - - - - - - Butte

ADMINISTRATIVE OFFICERS

EDWARD C. ELLIOTT, Ph. D. - - Chancellor, University of Montana
CHARLES H. CLAPP, Ph. D. - - - - - - - - - President
GEORGE W. CRAVEN, B. S. - - - - - - - - Vice-President
CHARLOTTE RUSSELL - - - - - - Registrar and Librarian

THE FACULTY

Professors

CHARLES H. CLAPP - - - - - - President and Professor of Geology and Mineralogy
Ph. D., Massachusetts Institute of Technology

GEORGE W. CRAVEN - - - - - Vice-President and Professor of Mechanics and Mathematics
B. S., Masachusetts Institute of Technology

LESTER J. HARTZELL - - - - - - - Professor of Chemistry
E. M., Colorado School of Mines

HORACE T. MANN - - - - - - - Professor of Metallurgy
B. S. in M. E., School of Mines, University of Missouri
M. S., School of Mines, University of Missouri
E. M., School of Mines, University of Missouri

THEODORE SIMONS - - - - - Professor of Mining Engineering
E. M. and C. E., Royal Polytechnicum, Munich

Associate Professors

ARTHUR E. ADAMI - - Associate Professor of Mining Engineering
E. M., Montana State School of Mines

Assistant Professors

E. RALPH BOWERSOX - - - - - Assistant Professor of Physics and Mathematics
B. S., Coe College
B. E. E., University of Iowa

WALTER T. SCOTT - - - Asst. Professor of English and Economics
Director of Student Activities
A. B., Westminster College of Pennsylvania
A. M., Harvard University

Instructors

B. E. THOMAS - - - - - - - - - - - - - Spanish
Platville State Normal College, Wisconsin
U. S. Government Interpreter in Spanish, 1900-1910

LEONARD R. DAEMS - - - - - - - - - Football Coach
A. B., Montana State University, 1916

Assistants

M. F. HALEY - - - - - - - - - Assistant in Mill Work
C. W. VAUPELL - - - - - - - - - Assistant in Geology

University of Montana

An Act of Congress, approved February 18, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana, in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined, and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer, whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1, 1916.

State School of Mines

The establishment of the State School of Mines, in Butte, was supervised by a commission appointed in 1895, consisting of F. E. Sargent, John Gillie, W. W. Dixon, J. H. Leysön, and C. W. Goodale. The lands of the School of Mines were used as a basis for the issue of bonds amounting to $120,000.00, and in 1896 the erection of the main building was begun. An additional appropriation of $26,300.00 was made in 1899 for equipment and maintenance. The school actually opened September 11, 1900, and the first class graduated in June, 1903.

The proceeds from the sale of the lands of the School of Mines have gone into a permanent fund, the interest from which, together with the rentals from unsold lands, has provided the school in recent years with most of its ordinary operating and capital expenditures. In 1907, $50,000.00 was appropriated for a new heating plant and mill building, and in 1910, $15,000.00 was appropriated for a gymnasium.

Nathan R. Leonard, Professor of Mathematics, was the first President of the institution. He was succeeded in 1906 by Charles H. Bowman, Professor of Mathematics, who had been connected with the school since its beginning. In 1918, President Bowman was granted a year's leave of absence, and Charles H. Clapp, Professor of Geology and Mineralogy, was appointed Acting President. Upon President Bowman's resignation in 1919, Professor Clapp became President.

PURPOSE AND SCOPE

The School of Mines has strictly confined itself to the preparation of young men for the mining profession, and by so doing has maintained a very high standard in this field. Before the war ninety per cent of its graduates were engaged in engineering work, very largely in Mining Engineering, and moreover many of its graduates hold positions of great responsibility. Although the distinction between a purely vocational school and an engineering college has always been kept clearly in mind, the school has given its students a practical knowledge of mining subjects, as well as a thorough education in theoretical principles. The fundamental subjects for all forms of engineering are given and special emphasis is laid upon the three main branches of mining—geology, mining and milling, and metallurgy.

LOCATION AND SURROUNDINGS

The State School of Mines is located just inside the western city limits of Butte. The site, on the southern bench of Big Butte, the extinct volcano which dominates the city, and from which the city takes its name, was donated by certain public-spirited citizens. It is easily accessible, since the street cars run within two blocks. The location is most commanding, and the view from the grounds overlooks the city, mines, and smelters, as well as the mountains which form the Continental Divide, and which surround the valley in which the city is situated on the east and south.

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city by the leading financiers and mining men of this country and Europe have given this locality such publicity that no one needs to be told of its leading position in the mining world.

In Butte are to be found, not only some of the largest copper and zinc mines of the world, but great mills and reduction plants. These are being continually enlarged and improved to meet the demands of greater industry. In addition, Butte is the site of other great engineering enterprises, and in few other places is there such an assemblage of machine shops, factories, and power plants as are to be found in the vicinity of the school. The city is, therefore, especially well fitted to meet the needs of a mining school.

In a very important sense all of these plants are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of the mining and engineering industry and are thoroughly conversant with the details of the work.

BUILDINGS

The main building, erected during 1895 to 1897, is a four-story pressed brick building. It measures one hundred and eighteen feet by ninety-four feet, and contains 37,000 square feet of floor space. In the basement are the chemical, metallurgical, and mechanical testing laboratories. The next two floors contain the recitation rooms, drafting rooms, mineralogy laboratory, and library. The fourth floor is devoted chiefly to museums, which contain extensive collections of minerals, ores, and mine models. In addition, there is also on this floor a petrograph laboratory and a blue print room.

In the rear of the main building is the mill building, completed in 1908. This building measures seventy feet by one hundred and ten feet. It contains the steam and electric power plant which heats the buildings and supplies power to the mill and laboratories. The mill is equipped to handle large quantities of ore conveniently, and affords treatment of ores by most of the standard processes now in practice.

The gymnasium building, to the north of the main building, was erected in 1910. It measures eighty-seven feet by fifty feet and contains a large gymnasium hall seventy feet by forty-five feet. At one end of the gymnasium is a balcony with a seating capacity for one hundred. The hall itself is used on special occasions as a general auditorium. Connected with the gymnasium are two parlors, a dressing room, and in the basement are the shower baths.

A new chemistry and metallurgical building is in course of erection and will be ready for occupation during the year 1920-1921. When complete it will cost $200,000.00 and will be thoroughly well equipped for its purposes.

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of the State. The total sum invested for this purpose now amounts to $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School. The descriptions which follow concern the more important articles that have been procured to illustrate or facilitate the work in the several departments.

Department of Mathematics

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor, abundantly supplied with blackboard space, terrestrial and celestial globes, some simple models, and a blackboard ruled in squares for tracing the graphs of equations and of natural phenomena.

Department of Mechanics

This department occupies three rooms on the first floor. The lecture room has a seating capacity of forty persons, and is provided with modern lecture room conveniences, such as water, gas, and electric current. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound, and light. The physical laboratory is housed temporarily in the old S. A. T. C. barracks building, and is equipped with heavy tables and apparatus for the measurement of physical constants. The apparatus consists of the usual assortment required in the measurement of density, elasticity, force of gravity, the latent heats of fusion and evaporation, and the mechanical equivalent of heat. There is also a photometer, together with the necessary accessories. For the measurements in electricity, there are provided ammeters, voltmeters, resistance boxes, Wheatstone bridges, galvanometers, batteries, and keys.

Mechanics Laboratory

The mechanics laboratory is located in the basement of the main building. A ten-horsepower three-phase induction motor drives direct and alternating current dynamos and the machine shop equipment. A switchboard provides connections for lines running to various parts of the building, also to motors and a rotary converter, and to a bank of transformers. It is possible to illustrate most of the connections in power transmission systems with the apparatus at hand, as well as to perform many interesting tests. A mercury arc rectifier is installed. The laboratory is also supplied with voltmeters and ammeters for both alternating and direct currents, rheostats, galvanometers, standard condensers, and resistance boxes, all necessary for electrical measurements.

The power plant for the mill contains two 80-horsepower boilers, a 75-horsepower high-speed engine belted to a 50 K. W. three-phase generator with switchboard and necessary instruments, and an air compressor with steam cylinders 8-inch by 10-inch, and air cylinders 7½-inch and 13-inch by 10-inch.

In connection with this laboratory there is a small shop equipped with the following metal working machines: One 13-inch screw-cutting lathe; one 16-inch shaper; one 22-inch drill. The tool cabinets are provided with an equipment of bench tools for both metal and wood work. There is also a blacksmith shop equipment for making and repairing tools and for giving such students as may desire it practice in forge work in iron and steel.

In addition to the material mentioned above, the testing laboratory has at its disposal a 100,000-pound Olson machine arranged for tensile, compression, and shearing tests. The accessories consist of the following: One compression micrometer especially designed for measuring the compression of stone cubes and other building material; one improved deflection instrument for measuring the deflection of beams subject to load; one Henning's improved micrometer instrument for measuring the compression or elongation of long specimens. The laboratory is also equipped with a cement testing outfit from Fairbanks, Morse & Co. All accessories, such as molds and sieves, are at hand for making a thorough study of this important subject. The apparatus for making a complete indicator and brake test of an engine is provided, also an apparatus for making a study of the heating power of coals.

Department of Chemistry

In this, as in all other departments where laboratory work is required, the demand for a large and varied equipment of apparatus and facilities for investigation is great, and the successful prosecution of the purpose for which the technical school is maintained is directly related to the perfection of this equipment. Nearly three-fourths of the entire first floor, or basement, of the School of Mines has been devoted to the use of this department, together with a lecture room on the second floor. In this space four laboratories have been fitted up, one for qualitative and quantitative analysis, one for metallurgy, and two special laboratories. To these have been added a balance room, a store room for laboratory supplies and a dispensary where the prepared tests for the students in the laboratories are kept.

The laboratories are furnished with working desks of the most approved pattern—each student having his own particular stand—where he is supplied with gas, water, blast, Bunsen burners, a rack for chemical reagents and a cupboard with lock and key, so that he can keep securely the apparatus and material assigned for his use. The laboratories are also supplied with hoods, in which are to be found hot plates, air baths, steam evaporating pans, hydrogen-sulphide apparatus, and a flue with a strong draft to draw off the noxious vapors. The laboratories for qualitative and quantitative analysis and for metallurgy are sufficient for the accommodation of 48 students each.

The students' balance room is provided with six analytical balances for the use of the student in the laboratories. These balances are placed on piers disconnected from the walls and floors of the building so that the vibration is reduced to a minimum.

The special laboratories and preparation rooms are equipped with modern conveniences for carrying on analytical and metallurgical work. In these rooms all the chemical reagents are prepared for the use of the student in the laboratories and all check analysis on the students' work is made. Two dark rooms are provided for photographic work, spectrum analysis, making blue prints and lantern slides.

The chemical lecture room, on the second floor, is provided with a demonstrating table, furnished with pneumatic trough, gas, water, hydrogen and oxygen blast, and direct and alternating currents of electricity up to 750 volts and 45 amperes. The demonstrating table is backed with a hood furnished with the same appurtenances as are provided for the hoods in the laboratories.

Department of Metallurgy

The assay laboratory is situated on the first, or basement, floor of the building, and is equipped with six of the latest model coal assay furnaces. There are also two gas assay furnaces and gasoline and electrical furnaces, which can be used for special work, and a gas retort and melting furnace for melting bullion, making alloys, retorting amalgam, and casting copper.

The pulp room adjoins the assay laboratory, where all charges are weighed and fluxed. Convenient cupboards are provided for storing samples. The silver and gold balances are located in the same room as the analytical balances, and are of the latest approved design.

The crusher room is provided with a Gates crusher, a Low crusher, an Englebach grinder capable of grinding pulp to 80 mesh, a Braun planetary pulverizer, a bucking board, tables upon which to roll the samples, and a series of drawers capable of holding 454 twenty-five-pound pulp samples. The supply of assay samples consists of a large number of copper, lead, gold, and silver ores, together with mattes, both copper and lead, slag, flue-dust, calcines, concentrates, tailings, and all smelter products from the copper and lead smelters and other plants of the State.

In the assay laboratory are located separate cyanide outfits for testing ore by the cyanide process. There is also located in this laboratory a calcining furnace capable of being used as a reverberatory or muffle roasting furnace, where large lots can be calcined, or a chlorination roast can be made for hyposulphite treatment.

There are arrangements for treating free-milling gold ores by the amalgamation process, as well as cyaniding the tailings from this process.

Gas analysis is at present carried on in the chemical lecture room. There is a very complete set of Hempel's gas apparatus, and analyses are made of gases of combustion, reverbatory and blast furnaces and of illuminating gases.

A dark room for students' use adjoins the balance room, which contains a large Kirchoff-Bunsen spectroscope and supplementary apparatus for qualitative analytical work in determining the presence of the alkali and alkaline earth metals by their volatilization in the non-luminous flame of the Bunsen burner. The spectroscope is provided with a scale for the determination of the exact location and relative position of the lines of the spectra, or, two spectra may be studied and compared at the same time.

The metallurgical laboratory occupies a building by itself. This building also contains the central heating plant and the engine and dynamo room. The metallurgical laboratory proper occupies a room 70 by 77 feet, half of which is devoted to ore dressing.

An equipment for making cyaniding tests provides for treating ores in five-ton lots. In this plant sands and slimes may be separated, dewatered, and treated separately. There are five vats, and two sump tanks, one a steel tank provided with air and mechanical agitation. All necessary filters and zinc boxes for making commercial tests are installed for use in this plant.

The laboratory contains a Wedge furnace designed to be used as a reverbatory or a muffler furnace. This furnace is mechanically rabbled and used in roasting ores in lots of one ton or more. There is also a lead-lined agitation barrel provided for experiments involving this type of apparatus.

A year ago there was added to the metallurgical section of the building, through the kindness of Mr. R. L. Lloyd, a complete laboratory size Dwight-Lloyd sintering machine, on which tests of several hundred pounds can be made. The roast and sintering of iron, copper, and lead ores of varying compositions and different fluxing can be carried out on a semi-commercial scale.

Mining and Ore Dressing

Two rooms, 24 by 31 feet, are provided in the main building for lectures in the various branches of mining and ore-dressing and for the drawing classes. Ample table room and individual drawer room are provided throughout; cabinets for filing drawings and drawing-boards are also provided. A large collection of blue prints, furnished by various manufacturing companies of mining machinery, is on hand and is used as an aid to the student in developing new work. The collection of parts of machines is gradually increasing. This material is of great assistance to the department in developing the work in machine design.

For the practical work in surveying the following instruments have been provided: Nine engineering transits; one from Buff & Buff, two from C. L. Berger & Sons, three from Gurley, one from Keuffel & Esser, one from Young & Son, and one from Eugene Dietzgen; six levels—one from Buff & Buff, one from Gurley, two from Keuffel & Esser, and one from Young & Son; one solar compass and one sextant with artificial horizon, from Gurley; two aneroids by Short & Mason (London), and a collection of minor apparatus, including Brunton compass, clinometers, Locke levels, chains, tapes, plumets, shaft plumbing equipment, rods, and flags, necessary in carrying on the work of the department. To this equipment has recently been added by donation a plane table with alidade, a Breithaupt & Sons' level with tripod, and a Tacher's calculating instrument.

The ore-dressing laboratory occupies a building by itself. This building also contains the central heating plant and the engine and dynamo room. The laboratory proper occupies a room 70 by 77 feet, half of which is devoted to ore dressing. The ore-dressing department consists of a set of storage bins with a capacity of from 80 to 100 tons of ore. One eight-inch by twelve-inch Dodge crusher, two sets of twelve and one-half-inch by twelve-inch rolls, two belt elevators, three trommels thirty inches in diameter and forty-eight inches long, one impact screen for dry screening, a duplex Callow screen for screening to forty and eighty mesh, three Evans and one Hartz jigs, one Huntington mill, one Wilfley table, one Deister-Overstrom concentrator, one Deister concentrator slimer, one four-foot Frue Vanner, and a Dings magnetic separator. There is also a three-stamp mill with amalgamating table. Accessories consist of classifiers, settling tanks, centrifugal and water pumps.

The mill is arranged in such a manner that complete tests on a commercial scale can be made on various kinds of ore by shifting the travel of the ore over such machines as are found to be best suited to treat any particular ore.

The laboratory also contains a miniature testing plant consisting of small-sized jigs, Wilfley table, hydraulic classifiers, and automatic feeder, for testing ore in quantities up to four pounds, preliminary to sending the ore through the large mill.

The museum of the school contains a very complete collection of the products from the ore-dressing plants at the Butte, Anaconda, and Great Falls smelters. These samples are extensively used in lectures on ore dressing, as they show in a most excellent manner the mechanical changes which a particle of ore undergoes during its travel through the various machines designed to separate the valuable metal from its gangue.

On the tables of the library may be found all the leading American technical magazines, as well as many foreign publications. The library also contains a valuable collection of text-books on all the subjects of civil and mining engineering, the use of which is open to all students upon application to the librarian. The office of the Professor of Mining and Ore Dressing also contains a large collection of catalogues, blue prints, and bulletins from the leading manufacturers of mining, milling, and smelting machinery. The school is indebted to these manufacturers for the supply of such catalogues and for the many extra copies which they have kindly furnished for distribution among the students.

Several mine maps, an ideal section of a Butte copper vein, a very attractive section through part of the Boston and Montana concentrator at Great Falls, and a great number of appropriate photographs and drawings decorate the walls of the museum and library; these include views of Montana mining towns, the Washoe smelter at Anaconda, of the Boston and Montana smelter at Great Falls, and of various mines and mills about the State. There is a large drawing to illustrate the method of sampling in use at the Taylor & Brunton Sampling Works (now the Washoe Sampling Works) at Butte, and also several drawings of the coal washery of the Cottonwood Coal Company. Finally, there are several diagrams illustrating the relative production of copper, silver, and gold in Montana and other states.

The various mine models, donated from time to time by leading mining companies of Butte, are exceedingly useful in demonstrating not only the geological features indicated on such models, but also the various phases and methods of shaft sinking, drifting, cross-cutting, and stoping, practiced in the mines represented by said models.

Department of Geology and Mineralogy

The department of geology and mineralogy occupies five rooms and parts of four others. On the second floor are the office, the lecture room, and the mineralogical laboratory, with provision in the library for certain maps; and on the third floor are the museums, the petrographic laboratory, dark room, and storage rooms.

The collection of minerals belonging to the department has been subjected to a two-fold division into museum specimens and student specimens. The student hand-specimens are placed in drawers, where they are accessible at all times; the material for laboratory work is kept in a separate cabinet; and the museum collection, which consists of the rarer, larger, and more delicate specimens, are kept under glass.

Of general usefulness in all courses of the department are the storage room, the dark room, the lecture room, and the office. The office is a capacious room fitted with desks and tables for the convenience of officers of the department, with cabinets for various collections and with bookcases for the departmental library. The lecture room is provided with wall maps, blackboards, and suitable desks and chairs. It is thirty-one feet long by twenty-four feet wide. One corner of the room is occupied by a geological relief map of the United States modeled on a section of a globe sixteen feet in diameter. This shows the topography, as well as the areal geology, of the entire country. A map-case five feet square contains the larger geological and areal maps. The dark room on the third floor contains apparatus and chemicals for photographic work. The storage room on the same floor contains materials for exchange.

An extensive collection of crystals is used not only to illustrate the lectures in crystallography but also as material for laboratory exercises. In addition to these real crystals, four series of crystal models are available, two of wood, one of celluloid, and one of glass. A reflection goniometer for the accurate measurement of crystal angles is installed in the dark room, while hand goniometers for laboratory work are kept in a case in the mineralogical laboratory.

The main museum occupies the north wing of the third floor of the building in a room thirty feet by sixty feet. Twenty-four large glass cases are devoted to ores, rocks, non-metallic products, specimens illustrating geological structures, and some of the larger fossils. Five cases are devoted to a special collection of minerals from the Butte district. All mineral collections are arranged according to the Dana classifications. A collection of one hundred and sixty gold crystals is kept in one of the cases. The mineral collections in the museum contain more than three thousand specimens. The systematic rock collection contains over fifteen hundred specimens. The museum, in all, contains over ten thousand specimens.

The mine model museum occupies a room thirty feet square in the southwest wing of the third floor of the building. Here are to be found many of the classic mine models used in the protracted mining litigation for which the Butte camp has been noted. These models are of many designs and styles and are of much practical use in illustrating the principles and facts of mining geology.

The mineralogical laboratory is thirty-one feet square and contains six laboratory tables capable of accommodating thirty-six students. Each student is provided with complete apparatus for the rapid determination of minerals by physical and chemical tests. A case in one corner of the laboratory contains the students' reference collection, containing over 300 mineral specimens and varieties, arranged according to Dana. Pycnometers, Westphal balances, Plattner scales, burretes, and miscellaneous laboratory supplies are at hand in another case. A collection of minerals for laboratory determination by the students is kept in a set of drawers in the office. Here, also, will be found a case of chemical and mineralogical reagents and appliances, a tile-topped table, a hood, and all the apparatus necessary for conducting qualitative and quantitative analysis of minerals and rocks. A

Greenough-Leitz binocular microscope is available for the mineralogy laboratory.

The working paleontological collection consists of over two thousand catalogued fossils, systematically arranged in cases in the museum.

For the work in field geology, the department is equipped with plane tables, allidades, Brunton compasses, clinometers, levels, aneroid barometers, tapes, tally registers, cameras, field glasses, and a complete camping outfit.

In the geological museum is a case containing seventeen petrographic microscopes. Ten of these are of the French type, made by Nachet in Paris; and seven of the German type, made by Leitz at Wetzlar. These microscopes are all provided with the necessary attachments for petrographic work, and the two of them, one Leitz and one Natchet, are of a larger size than the others, and are equipped with accessories for research work. The School owns a fine projection apparatus, which is provided with a large petrographic microscope for use in illustrating lectures in petrography.

A specially constructed cabinet in one corner of the museum contains five hundred slides of materials, six hundred thin sections of rocks, and one hundred slides of economic interest. The collection of mineral sections is supplemented by eight additional sets of fifteen more important mineral slides put up in individual boxes and a box containing seventeen slides especially prepared for use with the projection microscope.

The thin sections of rock are nearly all represented by hand specimens in the museum collections already described, so that the student may observe the microscopic character along with his microscopic work. A set of one hundred and four wooden models of crystals of the more important rock-forming minerals is also contained in the thin-section cabinet; while a collection of twenty glass models of rock-forming minerals after Grubenmann occupies a wall case.

The thin-section lathe room contains complete equipment for making thin sections of rocks and minerals, and for polishing opaque minerals. There are two electrically-driven lathes in this room; one is provided with two laps for rough and fine grinding, respectively; the other with a diamond wheel for cutting slides, and with two emery wheels for grinding. Emery, Canada balsam, thick glass, slides, covers, and all other supplies and accessories are at hand for use.

A camera for taking photo-micrographs is installed in the dark room.

The Library

Charlotte Russell, Librarian

The library is located on the second floor of the main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers, with its alcoves, a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others, is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast, and Geodetic Surveys; Reports on Forestry, Forest Reserves and Irrigation; of the Naval Observatories, Engineering Corps, and Bureau of Mines. Besides these, the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the more important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological, and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound, and thus furnish, in permanent form, more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and the periodical issues of other colleges.

ENDOWMENT

The maintenance of the State School of Mines is provided for by the State through biennium appropriations made by the Legislative Assembly. The sum provided for the biennium ending February 28, 1919, was $77,000.00. For the biennium ending February 28, 1921, the appropriation for maintenance is $90,000.00, and for buildings $100,000.00.

EXPENSES OF STUDENTS

FEES AND DEPOSITS

By the Act establishing the School of Mines, no charge of tuition is to be made where the student is a bona fide resident of Montana. Students from other states or countries will pay a tuition fee of $25.00 per semester, or $50.00 a year.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

By vote of the student body a student activity fee of $10.00 is asked from each student who registers. The proceeds from this fee are used as the necessary financial guarantee for athletics. In return for this payment, the student will be admitted free to all contests held under the direction of the student body.

To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each student is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is the list of deposits that are required:

Freshman Year

General Chemistry	$15.00

Sophomore Year

Plane Surveying	$10.00
Quantitative and Qualitative Analysis	15.00

Junior Year

Mine Surveying	$10.00
Assaying	10.00
Mineralogy	5.00

Senior Year

Metallurgy	$10.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

BOARD AND ROOM

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or vicinity, and at such places as are approved by the faculty. The expense for board and lodging is not higher than in other important cities of the west. Good board can be secured at $30.00 to $35.00 per month, while the cost of a good room, large enough for two persons, and including light and heat, will be from $15.00 to $25.00 per month, according to the location and the furnishings. Cost of text-books average about $25.00 a year. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as are found here.

RAILROAD FARE REFUNDS

In accordance with the provisions of Chapter 123, of the Session Laws of 1917, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round-trip between his Montana home and any institution of the University of Montana once each year, will be refunded. No war tax paid by any student will be refunded under any circumstances whatever.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance to the freshman class. This must include at least fifteen units of work. The term unit means one subject pursued for at least thirty-six weeks with not fewer than five recitations per week of forty-five or more minutes each. Two periods of laboratory, shop, or drawing work count the same as one recitation.

Of the fifteen units required, three are required in mathematics, distributed between algebra and plane and solid geometry; three are required in English composition and literature; and one is required in physics.

ADMISSION ON CERTIFICATE

Graduates of the accredited high schools of Montana obtain admission by presenting certificates of principals stating subjects taken, time given for each, and grade obtained.

Blanks for such certificates are furnished by the Registrar. These should be filed in the Registrar's office on or before the first day of registration.

ACCREDITED HIGH SCHOOLS, 1919-1920

District High Schools: Alberton, Anaconda, Baker, Belgrade, Belt, Big Sandy, Billings, Bridger, Broadview, Butte, Chinook, Columbia Falls, Columbus, Conrad, Corvallis, Culbertson, Cutbank, Darby, Fairview, Florence, Forsyth, Fromberg, Glasgow, Great Falls, Hamilton, Hardin, Harlem, Harlowton, Havre, Helena, Hobson, Hysham, Joliet, Jordan, Judith Gap, Laurel, Libby, Malta, Manhattan, Moore, Plains, Plentywood, Polson, Pony, Poplar, Ronan, Rosebud, Roundup, Ryegate, St. Ignatius, Shelby, Sheridan, Sidney, Stanford, Stevensville, Stockett, Terry, Thompson Falls, Three Forks, Valier, Victor, Virginia City, Whitefish, Whitehall, White Sulphur Springs, Worden.

County High Schools: Beaverhead (Dillon); Broadwater (Townsend); Carbon (Red Lodge); Choteau (Fort Benton); Custer (Miles City); Dawson (Glendive); Fergus (Lewistown); Flathead (Kalispell); Gallatin (Bozeman); Granite (Philipsburg); Jefferson (Boulder); Lincoln (Eureka); Missoula (Missoula); Park (Livingston); Powell (Deer Lodge); Sweet Grass (Big Timber); Teton (Chouteau); Wibaux (Wibaux).

Private Schools: Academy of Montana Wesleyan College (Helena); Academy of Mount St. Charles College (Helena); Butte Business College (Butte); Central High School (Butte); Loyola High School (Missoula); Mount Angela Ursuline Academy (Great Falls); Polytechnic Institute (Billings); Sacred Heart Academy (Missoula); St. Vincent's Academy (Helena).

Preparatory work done in other schools than those accredited may receive credit. Applicants from such schools should present certificates stating the same points as those given from accredited schools. Blanks for this purpose are furnished by the Registrar. When the evidence of certificate is not clear and satisfactory, examinations will be given.

Graduates of high schools not in Montana are admitted on certificates without examination if such high schools are accredited to their own state universities.

ADMISSION ON EXAMINATION

Applicants wishing to receive entrance credits on subjects for which they do not present satisfactory certificates are required to take examinations on days prescribed in the calendar. For the academic year 1920-1921 these days are September 15 and January 19.

Those who are preparing to take entrance examinations should correspond with the Registrar for suggestions in regard to such preparation.

CONDITIONAL ADMISSION

The entrance requirement of the completion of a four years' preparatory course, with at least fifteen units of credit, may be modified in individual cases by permitting students to enter conditionally, if otherwise qualified, if they are entitled to at least thirteen admission units. Students twenty years of age, or younger, who have thirteen units may be admitted as conditioned students only upon the specific recommendation of the principal of the high school in which they studied.

Entrance conditions must be removed within one year from the time of admission.

ADMISSION OF SPECIAL STUDENTS

Students twenty-one years of age or over, not candidates for degrees, may be admitted without the usual entrance units, as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired.

Special students may acquire status as regular students and become candidates for degrees upon complying with the rules applicable to such cases.

ADMISSION AS "WAR SPECIALS"

All students who have been in the military service may be admitted as "War Specials," regardless of high school graduation, upon the presentation of satisfactory evidence that they can carry the work successfully. "War Specials" may acquire status as regular students and become candidates for degrees after carrying one full year's work successfuly and upon complying with the rules of graduation.

ADMISSION TO ADVANCE STANDING

Students entering from collegiate departments of other colleges and universities must bring certificates of honorable dismissal. Upon presentation of the proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

CREDIT FOR WAR SERVICE

Credits toward the degrees of the college will be granted for definite and measurable attainments of mind resulting from service in the army and navy of the United States. The number of credits allowed for military service will be determined by the instructor in the branch in which application for credits is made, subject to approval of the committee on military credit and advance standing. Application for war service credits must be made by the student not later than twelve months after his discharge from service.

REQUIREMENTS FOR GRADUATION

The School confers the degree of Mining Engineer upon those who have completed the course as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

MISCELLANEOUS INFORMATION

SCHOLARSHIP AND CONDUCT

The School of Mines requires all its students to conform to the usual standards of society and law-abiding citizenship, and to manifest a serious purpose by maintaining satisfactory standing in the courses which they undertake. No student will be permitted to continue his connection with the school who shows persistent unwillingness or inability to comply with these requirements.

Prompt attendance is required of all students at the regular class exercises and satisfactory excuses must be rendered to the instructor in charge for all absences from his class. If the total number of absences, excused or unexcused, in any class exercise amounts to one-fifth of the total number required for the semester, the student may be debarred from further attendance in that class or department of study.

SCHOLARSHIP GRADES

Each student shall receive a final mark at the end of each semester. The passing grade shall be seventy per cent. If a student's grade in any subject shall fall below fifty-five per cent, the grade registered shall be "failed," and the work must be repeated in class. Also, further attendance in that line of study, if it is a study continued to another semester, must be discontinued until the passing grade is obtained on the work which was a failure. In case a student's grade in any subject falls between fifty-five and seventy per cent, he is conditioned in that subject, but may continue and receive credit for the work, provided the condition is removed within a reasonable time after the condition has been incurred.

A student may withdraw from a course in which he has registered during the first two weeks with the consent of the instructor, registrar, and president. After this time he may withdraw only with the consent of the faculty. All withdrawals must be formal and must be recorded by the student with the registrar.

EMPLOYMENT AND AID FOR STUDENTS

A large number of students of the School of Mines earn either the whole or a part of their expenses while in college. The School cannot guarantee work for students, but under ordinary conditions of mining most of the students find work in the mines for two shifts a week. A few students find work about the school as stenographers and laboratory assistants. During the summer vacations students readily find profitable employment in many occupations, but especially in mining.

HIGH SCHOOL HONOR SCHOLARSHIPS

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana, it is the declared policy of the State Board of Education to provide for the awarding of scholarships, to be known as "High School Honor Scholarships," to graduates of the accredited high schools of the state.

In the administration of this policy the number of scholarships awarded each year in any accredited high school will depend upon the number of graduates, as hereinafter specified. In no case, however, will more than two such scholarships be awarded each year in any high school for any one of the institutions of the University. High School Honor Scholarships may be awarded only to students who belong to the highest one-fourth of the graduating class in scholarship.

The following general regulations will govern the awarding of High School Honor Scolarships:

1. Upon the presentation of the required certificate from the principal, the Chancellor of the University will authorize the award, each year, to graduates of each of the accredited public high schools of the state, of High School Honor Scholarships for the component institutions of the University of Montana.

2. To be eligible for a High School Honor Scholarship the individual must be certified by the principal:

   (a) To be a graduate of an accredited high school of the state;

   (b) To belong to the highest one-fourth of his class in scholarship;

   (c) To be a student of ability and promise of success in college or professional school; and

   (d) To be the highest in scholarship of those members of the graduating class desiring to attend the University institution for which the Honor Scholarship is to be awarded.

3. No more than one Honor Scholarship may be awarded to the membership of any graduating class having seven or fewer graduates; no more than two scholarships may be awarded to the membership of any graduating class having eight to eleven graduates; no more than three scholarships may be awarded to the membership of any graduating class having twelve to fifteen graduates; no more than four scholarships may be awarded to the membership of any graduating class having sixteen or more graduates.

4. No more than two High School Honor Scholarships may be awarded each year in any high school for any one of the institutions of the University.

5. The holders of High School Honor Scholarships shall be exempted from the payment of all customary fees except the student activity fees and the special fees in the School of Music. All holders

of High School Honor Scholarships will be expected to make the required course deposits.

6. Any High School Honor Scholarship will become void unless the holder enters one of the institutions of the University within eighteen months after graduation from the high school. The holder of a High School Honor Scholarship must give notice to the Registrar of the institution of his intention to utilize the scholarship not later than September 1st of the year in which he intends to enter the institution.

7. Any High School Honor Scholarship will be valid only as long as the holder is in attendance upon some regular course leading to graduation; provided, however, that no High School Honor Scholarship shall be valid for a period longer than five years.

8. In case any individual to whom has been awarded a High School Honor Scholarship relinquishes the scholarship without entering the institution, or for any reason fails to enter the institution in compliance with Section 6 of these regulations, the high school principal may certify the next ranking eligible member of the same graduating class desiring to enter the particular institution.

9. The privileges of a High School Honor Scholarship may be retained only so long as the holder maintains a standard in scholarship and regularity of attendance satisfactory to the faculty of the institution at which he is in attendance.

MILITARY SERVICE SCHOLARSHIPS

Upon the proper certification of the president that a student has rendered military or naval service to the nation and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service Scholarship to such student. The holders of such scholarships, throughout the course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

By special action of the State Board of Education the privileges of the Military Service Scholarship are extended to all students of the University of Montana who met the requirements for membership in the Students' Army Training Corps, and to all who actually took up work in one of the corps of the University of Montana, but were deprived of induction through the action of the War Department cancelling all inductions which were not complete November 11, 1918.

GENERAL UNIVERSITY STUDENT LOAN FUNDS

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds, which are available for students in the junior and senior classes of any of the institutions of the University of Montana who are unable to continue their studies without financial aid and are satisfactorily recommended as to character and scholarship by the dean or director or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loans must be repaid within one year from the time of borrowing or, in exceptional cases, one year after graduation. Loans bear two per cent interest.

Application blanks and a statement of detailed regulations governing these loans may be obtained from the Registrar.

AUXILIARY WORK

BUREAU OF MINES AND METALLURGY.

The Legislative Assembly of Montana for 1919 (Chapter 161, Page 311), established in the State School of Mines a State Bureau of Mines and Metallurgy. A fund of $20,000.00, necessary for the maintenance of the Bureau, was appropriated for the biennium ending Feb. 28, 1921.

The bureau is organized into four major departments, Administration, Geology, Mining, and Metallurgy and Safety.

The object and duties of the bureau, as specified by law, are as follows:

1. To collect, to compile, and to publish statistics, relative to Montana geology, mining, milling, and metallurgy.

2. To collect typical geological and mineral specimens and samples of products; to collect photographs, models, and drawings of appliances used in mines, mills, and smelters of Montana.

3. To collect a library and a bibliography of literature pertaining to or useful for the progress of geology, mining, milling, and smelting in Montana.

4. To study the geological formations of the State with special reference to their economic mineral resources, both metallic and non-metallic.

5. To examine the topography and physical features of the State with reference to their practical bearing upon the occupation of the people.

6. To study the mining, milling, and smelting operations carried on in the State, with special reference to their improvement.

7. To prepare and to publish bulletins and reports, with necessary illustrations and maps, which shall embrace both a general and a detailed description of the natural resources and geology, mines, mills, and reduction plants of the State.

8. To make qualitative examinations of rocks and mineral samples.

9. To consider such other scientific and economic problems as in the judgment of the State Board of Education are of value to the people of the State.

10. To communicate special information on Montana geology, mining, and metallurgy.

11. To co-operate with the other departments of the University of Montana, with the State Mine Inspector, and with other departments of the State Government as may be mutually beneficial; and to co-operate with the United States Geological Survey, and with the United States Bureau of Mines, in accordance with the regulations of those institutions.

The results of the work of the bureau are published in bulletins and circulars which are distributed free of cost to those requesting them. The bureau has been established primarily for service, and so far as is reasonable all problems and questions relating to the mineral resources or mining and metallurgical industry of the State will receive careful consideration. All samples and letters should be addressed to the State Bureau of Mines and Metallurgy, Butte, Montana.

STUDENT ACTIVITIES

While it is impossible in an engineering school to maintain as wide a range of student activities outside of classroom instruction as is possible in colleges which specialize in other lines of work, yet it is recognized that these activities are, and should be, a part of the life of a normal student. As much encouragement is given them as is consistent with good work in the courses of study.

THE A. S. S. M.

The Associated Students of the School of Mines is a regularly organized association of which any student may be a member if he has paid the student activity fee. It has general supervision over all matters in which the students as a whole are interested. It also has the power to determine to what extent student government may apply in controlling traditions, general conduct, and the action to be taken when student rules are broken. General control of athletics, student publications, debating, and other activities which affect all the student body is in its hands.

ATHLETICS

As much encouragement is given to intercollegiate and interclass athletics as is possible in a school of this type. Teams were maintained last year in football and basketball, and schedules were played with Montana and other Northwestern colleges appearing on the list. The eligibility rules of the Northwest Intercollegiate Conference are in force. Competent coaching is secured for the various athletic teams. Within a short time it is hoped that the facilities of the school for athletics will be increased and that it may be possible to add track and baseball to the sports now maintained. In Butte there are several good gymnasiums which have swimming pools and handball courts. No student need lack for physical exercise and games in good surroundings if he desires them.

THE MINING SOCIETY

The Mining Society is an organization to promote the discussion of mining and engineering topics and to develop good fellowship among the men in attendance. Smokers are held every few weeks at which speak men of prominence in mining and engineering work who have subjects of practical interest to discuss. The Society is affiliated with the American Institute of Mining and Metallurgical Engineers as a Junior Branch.

THE DANCING CLUB

The Dancing Club has general supervision over all social affairs given by the student body, as a whole, or by the various classes, as a whole. Under its guidance are held the Junior Prom, the Christmas Dance, and other social events of the school year.

JUNIOR AND SENIOR TRIPS

It has long been the custom for the Juniors and Seniors to take an inspection trip to Montana and other mining districts before work ends in the Spring. These trips are planned with the advice and approval of the faculty and they are conducted under the direction of members of the faculty. It is required that the inspection work on these trips and the reports asked afterwards be satisfactory to the faculty members in charge before credit is given towards graduation.

Organization of Instruction

The State School of Mines offers at present only one course leading to the degree of Mining Engineer. However, courses in metallurgical engineering and mining geology will be offered to the class graduating in 1922 and thereafter.

As now organized, the school consists of four major departments, mathematics and mechanics, metallurgy and chemistry, geology and mineralogy, and mining engineering. Mathematics and mechanics are required as fundamental for all forms of engineering, and the other three departments emphasize the three main branches of mining. In addition to the subjects offered in these major departments, classes are given in English composition, economics and law, physics, and Spanish.

COURSES IN MINING ENGINEERING

For the Class of 1924 and Thereafter

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	3	3
Geology	3	1½
General Chemistry:		
Laboratory	6	4½
Lectures and Recitations	4	
Mechanical Drawing and Descriptive Geometry	9	3
	29	17

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	3	3
Plane Surveying	3	3
Geology	3	1½
General Chemistry:		
Lectures and Recitations	3	5½
Qualitative Anal.-Lab.	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mech.	4	4
Physics	3	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mining	2	2
Mine Surveying, Theory	2	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Structural Geology	2	1
Metallurgy	2	1½
Fire Assaying	1	½
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2-wk.	2
Mapping	3	
Thermodynamics and Mechanical Engineering	3	3
Mechanics	3	3
Physics Laboratory	6	2
	30	18

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology of North America:		
Lectures	2	2
Laboratory	3	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
Graphics	3	1
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	4
Field Geology	3-wk.	1½
	28	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
	28	16

COURSES IN MINING ENGINEERING

For the Classes of 1922 and 1923

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	5
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
General Chemistry:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics:		
Lectures and Recitations	4	4
Laboratory	3	
Geology	3	2
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy	2	1½
Fire Assaying	1	1½
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2 wk.	2
Drawing	3	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
	30	18

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	4
Field Geology	3-wk.	1½
	28	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
	28	16

COURSES IN MINING ENGINEERING

For the Classes of 1920 and 1921

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	3	3
Physics	4	3
Mineralogy:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	3	1
Plane Surveying, Field Work	4-wk.	2
	28	17

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	3	3
Physics	4	3
Mineralogy:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Topographic Drawing	3	1
	30	16

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mechanics	5	4
Geology:		
Lectures	3	3
Laboratory	3	
Metallurgy	3	2
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2-wk.	2
Drawing	3	
Graphics	3	1
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mechanics and Hydraulics	5	4
Geology:		
Lectures	3	3
Laboratory	3	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	3
Laboratory	6	
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	2	2
Ore Dressing:		
Lectures	2	3
Design	6	
Economic Geology	5	3
Field Geology	3-wk.	1½
Mechanical Engineering	3	2
	30	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	2	2
Ore Dressing:		
Lectures	2	3
Design	6	
Mining Geology:		
Lectures	5	4
Field Work	3	
Power Transmission	3	2
	30	16

COURSES IN METALLURGICAL ENGINEERING

For the Class of 1924 and Thereafter

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	3	3
Geology	3	1½
General Chemistry:		
Lectures and Recitation	3	5½
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	17

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	3	3
Plane Surveying	3	3
Geology	3	1½
Qualitative Anal. Lab.:		
Lectures and Recitation	3	5½
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics	3	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	4
Laboratory	9	
Mining	2	2
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Structural Geology	2	1
Metallurgy:		
Lectures	2	2½
Drawing	3	
Fire Assaying	1	½
Electro Chemistry:		
Lectures	2	3
Laboratory	6	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
Physics Laboratory	6	2
	30	16

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology of North America:		
Lectures	2	2
Laboratory	3	
Metallurgy	3	2
Assaying	6	2
Physical Chemistry:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
Graphics	3	1
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Electro Metallurgy	3	3
Metallurgy Problems	3	3
	26	16

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Metallurgy:		
Lectures	3	4
Laboratory	3	
Metallurgy Problems	2	2
	25	15

COURSES IN METALLURGICAL ENGINEERING

For the Classes of 1922 and 1923

FRESHMEN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	5
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
General Chemistry:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics:		
Lectures and Recitations	4	4
Laboratory	3	
Geology	3	2
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy:		
Lectures	2	2½
Drawing	3	
Fire Assaying	1	½
Electro Chemistry:		
Lectures	2	3
Laboratory	6	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
	30	16

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Assaying	6	2
Physical Chemistry:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Electro Metallurgy	3	3
Metallurgy Problems	3	3
	26	16

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Metallurgy:		
Lectures	3	4
Laboratory	3	
Metallurgy Problems	2	2
	25	15

CHEMISTRY

PROFESSOR, L. J. HARTZELL.

General Chemistry: 2 S. Continuous. 5 credits. Deposit, $15.00. Freshmen. Lectures, recitations, and laboratory. The object of the course is to develop the underlying principles of the subject as a basis for all subsequent work in the department. The student is drilled on the laws governing chemical phenomena, and is made familiar with the principal characteristics and relations of the elements. The work is illustrated by experiments, conducted either by the instructor or the student. Text: "General Chemistry for Colleges," by Alexander Smith. Mr. Hartzell.

Qualitative Analysis: 1 S. Spring. 6 credits. Deposit, $15.00. Freshmen. Prerequisite, General Chemistry. Lectures, recitations, and laboratory. The course is designed to instruct the student in the general scheme for the separation and detection of the metallic elements and the more common acid radicals. Chemical arithmetic or stochiometry is given during the latter part of the course. Text: "Qualitative Analysis," by Prescott and Johnson. Mr. Hartzell.

Quantitative Analysis: 2 S. Continuous. 6 credits. Deposit, $15.00. Sophomores. Prerequisite, Qualitative Analysis. Lectures, recitations, and laboratory. The course is designed to meet the needs of the mining engineer, and the object is to develop the student's ability to perform quantitative analysis rapidly and accurately. The problems in the laboratory are selected as far as possible from the work of the practitioner in the smelters and mines of the West. The course emphasizes all the general methods of analysis as applied to limestones; dolomites; ores of iron, mercury, lead, zinc, copper, arsenic, antimony, and tin; rocks; cements; slags; mattes;. and water.

The principles of acidimetry and alkalimetry are studied and explained and demonstrated by the analysis of acid and alkaline solutions.

While the practical features of quantitative analysis are emphasized, these are primarily employed to develop the theory and to show the practical application of chemical theory. Text: A. H. Low, "Technical Ore Analysis." Lecture Notes. Mr. Hartzell.

Electro-Chemistry: 1 S. Fall. 3 credits. Deposit, $10.00. Juniors. Prerequisites: General Chemistry, Physics, Qualitative and Quantitative Analysis. Two lectures and six laboratory hours a week. This course is a study of the theories of electrolysis, conductance, of electrolytes, electro-motive force, and polarization. The laboratory work takes up the measurements of conductivity, electro-motive force, and resistance simple potentials; electro-disposition of metals; and electro-analysis. Texts: Findlay, "Practical Physical Chemistry", and Watts, "Laboratory Course in Electro-Chemistry." Mr. Hartzell.

Physical Chemistry: 1 S. Spring. 2 credits. Deposit, $10.00. Juniors. Prerequisites, General Chemistry, Physics, Qualitative and Quantitative Analysis. Two lectures and nine laboratory hours a week. While some attention is paid to the application of physical methods of chemistry, and to the qualitative and quantitative theories of chemical equilibria, as given by the phase rule and the mass law, the special stress in this course is laid on the study of the effects of the equilibrium factors on chemical reaction. Text: Lewis, "A System of Physical Chemistry." Laboratory manual: Findlay, "Practical Physical Chemistry." Mr. Hartzell.

Note: Physical Chemistry and Electro-Chemistry are not required in the Mining Engineering Course.

ENGLISH AND ECONOMICS

PROFESSOR. W. T. SCOTT

English Composition: 2 S. Continuous. 3 credits. Freshmen. Lectures and recitations. The purpose of the course is to arouse the student to a realization of the importance of being able to use good English, and to teach him how to write and speak clearly, accurately, and easily, especially upon scientific and engineering topics. The course also aims to prepare for the ordinary use of English in business and to explain the principles which lie back of business usage. The first semester includes work in the fundamentals of composition, speaking, and parliamentary law. The second semester specializes on business English, but continues the work in speaking, emphasizing its use in business. Texts: "The Century Handbook of Writing," by Garland Greever and Easley S. Jones; "Handbook of Parliamentary Law," by F. M. Gregg; "Practical Business English," by O. C. Gallagher and Leonard B. Moulton. Mr. Scott.

Engineering English: 2 S. Continuous. 4 credits. Sophomores. Oral and written exercises in describing and explaining mechanical devices, engineering processes, and scientific principles; followed by formal written reports such as are required of engineers; and completed by oral reports which must stand up under group criticism and questioning. Texts: "Technical Writing," by T. A. Rickard, "The Composition of Technical Papers," by Homer Andrew Watt. Mr. Scott.

Engineering Economics: 2 S. Continuous. 4 credits. Juniors. Lectures and recitations, elementary economics, sociology, business management, and law as applied to the mining industry in particular and to the engineering industry in general. Attention is also given to modern industrial problems which affect the mining industry particularly. Text: "The Introduction to the Study of Economics," by Charles J. Bullock. Mr. Scott.

GEOLOGY AND MINERALOGY

PROFESSOR, C. H. CLAPP. ASSISTANT, C. W. VAUPELL.

Mineralogy: 2 S. Continuous. 3 credits. Deposit, $5.00. Juniors. Prerequisite, Qualitative Analysis. Lectures, recitations, laboratory, museum study, and field excursions. The purpose of the course in mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests, and by sight, is the object sought. The course is divided into crystallography, blow pipe analysis, and determinative and descriptive mineralogy. Text: "Dana's Manual of Mineralogy," by W. E. Ford. Mr. Clapp and Mr. Vaupell.

Geology: 2 S. Continuous. 6 credits. Sophomores. Freshmen. 3 credits. (No laboratory work for Freshmen). Prerequisite, Qualitative Analysis. Lectures, laboratory, and field excursions. Physiographic, dynamic, and structural geology are first studied, followed by a brief outline of historical geology and geology of North America. Montana geology is given particular attention. The needs of the mining engineer are kept constantly in mind, and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text: "Textbook of Geology," by Pirsson and Schuchert. Mr. Clapp and Mr. Vaupell.

Economic Geology: 1 S. Fall. 4 credits. Seniors. Prerequisite, Geology and Mineralogy. Lectures and recitations. A course in the more theoretical aspects of the geology of ore deposits, including structural features, transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and non-metallic, especially those of North America, is gained by the preparation of reports and maps. Text: "Mineral Deposits," by W. Lindgren. Mr. Clapp.

Field Geology: Three weeks field work. 1½ credits. Seniors. Prerequisite, Geology, Mineralogy, and Plane Surveying. A course in the various methods of geological surveys, including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared, but material for laboratory study is collected and geological reports are written. Mr. Clapp.

Mining Geology: 1 S. Spring. 5 credits. Seniors. Prerequisitie, Economic and Field Geology. Lectures, recitations, and field work. Application of geology of ore deposits to practical mining problems, and two weeks of field work in the principles and practice of underground geologic mapping, with the preparation of geological reports on the mines examined. Mr. Clapp.

MATHEMATICS AND MECHANICS

PROFESSOR, GEORGE W. CRAVEN. ASSOCIATE PROFESSOR, A. E. ADAMI.
ASSISTANT PROFESSOR, E. RALPH BOWERSOX.

Algebra: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. After a preliminary course, designed to drill the student in the fundamental algebraic operations, and in the statement and solution of problems, those operations of advanced algebra, which will be of use to the student in future engineering courses, are carefully studied. Special attention is given to the use and theory of exponents and logarithms, simultaneous quadratic equations, variation, the more common series with their practical applications, and undetermined coefficients. Text: "College Algebra," by Wentworth. Mr. Bowersox.

Trigonometry: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. In plane trigonometry the subjects of primary importance are goniometry, solutions of right and oblique triangles, and practical problems. Those considered in spherical trigonometry are the solution of right and oblique spherical triangles, and their development and practical application to surveying and measurement. Text: "Plane and Spherical Trigonometry," by Wentworth. Mr. Adami.

Analytical Geometry: 1 S. Spring. 3 credits. Freshmen. Prerequisites, Algebra, Trigonometry. Lectures and recitations. The material gathered from algebra, geometry, and trigonometry is combined in a manner which leads to a practical knowledge of these branches of mathematics. The student is required to study and plot accurately numerous problems covering such topics as the point and straight line in the plane, different systems of co-ordinates, conic sections, higher plane curves, the point and straight line in space, curved surfaces, and surfaces of revolution. Toward the end of the course the student is required to study various mechanical movements, to devise movements, and to determine the laws and equations involved. Text: "New Analytical Geometry," by Smith and Gale. Mr. Bowersox.

Calculus: 1 S. Fall. 4 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures and recitations. Differential and integral calculus covering the following subjects: Differentiations, tangents, normals, subtangents, subnormals, asymptotes, indeterminate forms, logarithms, maxima and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text: "Differential and Integral Calculus," by Taylor. Mr. Craven.

Calculus and Analytical Mechanics: 1 S. Spring. 4 credits. Sophomores. Prerequisite, Calculus. Lectures and recitations. A continuation of the course in Calculus, and a consideration of the theoretical principles of mechanics. Text: "Differential and Integral Calculus," by Taylor. Mr. Craven.

Mechanics: 1 S. Fall. 4 credits. Juniors. Prerequisite, Calculus and Analytical Mechanics. Lectures and recitations. In the course are considered the strength of materials, the laws of elasticity and resiliency, impact, fatigue, and the theory of beams and columns or struts. The course also includes a study of the properties of various building materials—the metals, timber, stone, brick, and cement.

It is the object of this course to direct the attention of the student to the elements of machinery design. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keys, pipes and pipe fittings, shafting, couplings, cylinders, and structural steel design. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, and ropes. Special attention is given to the installation and maintenance of machinery, and in this connection a great deal of practical information is gained by frequent visits to the repair shops of the Butte mines. Text: "Mechanics of Materials," by Merriman. Mr. Craven.

Mechanics and Hydraulics: 1 S. Spring. 4 credits. Juniors. Prerequisite, Mechanics. Lectures and recitations. Following the conclusion of the course in mechanics, the course in hydraulics is introduced with a study of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involving the flow of water through orifices, over weirs, through pipes, flues, and conduits. Attention is given to the design of dams and their adjuncts and to the investigation of the various water wheels, and governing devices. Text: "Treatise on Hydraulics," by Merriman. Mr. Craven.

Physics: 2 S. Continuous. 6 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures, recitations, and laboratory. The topics considered are: Concurrent and parallel forces; center of gravity; inertia and rotation; friction and work; simple machines; mechanics of fluids; nature and measurement of heat and its application to the steam engine, and to the transmission of energy by means of compressed air; electricity and magnetism; a brief study of light and sound, including a study of optical instruments and of the phenomena met in the study of mineralogy and petrography; and the application of electricity to dynamos, motors, transmission of energy, and lighting. Text: "College Physics," by Kimball. Mr. Bowersox.

Mechanical Engineering: 1 S. Fall. 2 credits. Seniors. Prerequisites, Physics, Mechanics, and Hydraulics. Lectures, recitations, and excursions. Following a short course in thermodynamics, a systematic study is made of the mechanism of engines, simple, condensing, and continuous expansion, foundations, bed plates, steamboilers and their adjuncts, and their setting and management, design and construction of chimneys, and general plans for power houses. Text: "Steam Engines and Boilers," by J. H. Kinearly.

In addition, a series of descriptive lectures of pumps and pump details, and the construction and management of mining pumps, is given. Text: "Pumping Machinery," by W. M. Barr. Mr. Craven.

Power Transmission: 1S. Spring. 2 credits. Seniors. Prerequisite, Physics, Mechanics, and Hydraulics. Lectures, recitations, and excursions. The student's attention is directed to the general conditions of power transmission, synchronous and induction motors, current reorganizers, hydraulic development, organization of a power station, line construction, centers of distribution, commercial problems, and measurement of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this field. Text: "Power Transmission," by Bell. Mr. Craven.

Mechanical Drawing and Descriptive Geometry: 2 S. Continuous. 5 credits. Freshmen. Lectures and drawing room. The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. Students are required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to them. It is the aim to guard against the copying of drawings, so that the student learns to think and construct for himself. The course includes practice in freehand lettering, and the student is taught the use of water-color as applied to engineering drawing. Practice is also given in coloring maps and shading parts of machine drawings. As far as possible the problems in drawings are taken from those met by the engineer in practice. The study of descriptive geometry is completed and applied to engineering design. Texts: "Mechanical Drawing" and "Descriptive Geometry," by L. Faunce. Mr. Craven and Mr. Adami.

Graphics: 1 S. Fall, Juniors. Spring, Sophomores. 1 credit. Prerequisites, Mechanical Drawing and Descriptive Geometry. Lectures, recitations, and drawing. The course in graphics is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge, or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind, and snow. Text: "Steel Mill Buildings," by Ketchum. Mr. Craven.

METALLURGY

PROFESSOR, H. T. MANN ASSISTANT, H. F. HALEY.

Principles of Metallurgy: 1 S. Fall. 1½ credits. Prerequisite, Quantitative Analysis and Physics. Lectures, recitations, plant inspections, and reports. The course is an introduction to the study of metallurgy. The nature of the metals is considered, with outlines of the principles and practices for the winning of all the common metals. The metallurgical industries have their nature and importance presented, after which those operations and processes common to several metals are studied. Students are taken to local plants, have the work explained, and are then required to prepare suitable reports. Mr. Mann.

Metallurgy Laboratory. 1 S. 1 credit. Juniors in Metallurgical Engineering. Prerequisite, to be accompanied by Principles of Metallurgy. This course is intended for men who wish a degree in metallurgical engineering. It will take up in detail Pyrometry, Refractories, Fuel Testing, Gas Analysis, the Physical Properties of Metals, Cooling Curves, Roasting, Study of Slags, Use of the Microscope in Metallurgy, and Ore Dressing and Heat Conduction. Mr. Mann.

Metallurgy of Copper: 1 S. 2 credits. Juniors. Prerequisite, Principles of Metallurgy. The metallurgy of copper is considered along the following lines: The properties and uses of copper, its compounds, and its alloys; the markets for copper and its ores and the principles underlying their sale and price; the ores of copper; the smelting of roasted and oxidized ores of copper to black copper, touched on briefly; the roasting of copper ores as a preliminary to blast-furnace and reverberatory smelting; the handling of the smoke from copper furnaces to save the values contained therein and to remove from these gases their injurious constituents; the smelting of roasted ores to matte in the reverberatory furnace; the smelting of roasted ore to matte in the blast furnace, either with or without the attempt to volatilize a considerable portion of the sulphur; the smelting of raw massive sulphides to matte in the blast furnace, or pyrite smelting; the converting of copper matte to blister copper in the basic and in the acid converter; the furnace refining of copper; the production of copper from matte by the various roast-reaction of roast smelting methods; the electrolytic refining of copper; and hydrometallurgy of copper. Mr. Mann.

General Metallurgy: 1 S. Fall. 6 credits. Deposit, $15.00. Seniors. Prerequisite, Principles of Metallurgy and Fire Assaying. This course includes a study of the metallurgy of lead, and gold and silver.

Metallurgy of Lead: The course in the metallurgy of lead includes work along the following general lines: The properties and uses of lead, its alloys, and compounds; the ores of lead and the methods and principles of their sale; the principles and practice of sampling the ores and their products; the general principles used in the winning of lead from its ores; the treatment of lead ores in the reverberatory smelting furnace; the winning of lead from its ores by smelting in the ore hearth, or Scotch hearth, considerable attention being paid to this method on account of its importance with the ores of the Mississippi Valley; the roasting of lead ores and the strides that have recently been made in this important preliminary to the lead blast furnace; the winning of ores in the lead blast furnace; (this heading is, of course, an important one in the subject, and under it are taken up the blast-furnace plant, the chemistry of the blast-furnace, the calculation of furnace charges, the calculation of the costs of smelting, and the handling of products, particularly the smoke or fume); the desilveration of base bullion by means of the Parkes, Pattison, and cupellation processes, as well as by the Betts process. Throughout this course, as well as the other courses of this department, the work is accompanied by problems which bring out the ideas which the classroom work considers.

Metallurgy of Gold and Silver: The study of the metallurgy of gold includes lectures and recitations along the following general lines: The properties of gold, gold alloys, and the compounds of gold; the winning of gold from placer ground by dredging and hydraulicking, including methods of investigating the value of placers; the chlorination and bromination of gold ores, considered more in the light of the historic value of these processes than for their present importance as schemes of gold extraction; the amalgamation methods of silver and gold ores are taken up in detail in the course on ore dressing. The study of the metallurgy of silver is considered as suggested by the following topics: The properties of silver, of its alloys, and of its compounds; the winning of silver from its ores by the various leaching schemes that were formerly of greater importance than at present, schemes which include the Augustin process, the Ziervogel or Argo process, and the various methods of hyposulphite leaching, each considered only briefly. The greater part of the time of the course in gold and silver is devoted to the study of the cyanide process, which is considered in detail. The parting of gold and silver by the various acid and electrolytic schemes and the winning of gold and silver from their ores by the various smelting schemes are considered under the head of metallurgy of lead and copper. Mr. Mann and Mr. Haley.

General Metallurgy: 1 S. Spring. 5 credits. Deposit, $15.00. Seniors. Prerequisites, Metallurgy of Copper and Lead, and Fire Assaying. This course includes a study of the metallurgy of zinc, iron and steel, tin, antimony, and aluminum.

The metallurgy of zinc is considered under the following headings:

The properties and uses of zinc, its alloys, and compounds; the ores of zinc and the methods and the principles underlying their sale; the roasting of zinc ores, with a brief study of the use of zinc ores as a source of sulphuric acid; the distillation of zinc ores and the furnaces suited for this purpose; the factors on which the success of the distillation depends; the manufacture of retorts and condensers; the laws of condensation of vapors to liquids and their application to the condensation of zinc vapors; the products of zinc smelting, and the methods of handling and treating these products; the cost of smelting zinc ores figured on the basis of a number of typical ores; the refining of spelter; the markets for spelter and the various brands of spelter; special schemes other than the ordinary methods that have been used or proposed for use in the winning of zinc from its ores; the manufacture of zinc oxide pigment. Throughout this course problems are given to illustrate the ideas set forth in the class.

The metallurgy of iron and steel takes up the following topics: The use of ferrous materials; the production and properties of pig-iron, cast-iron, wrought-iron, and the various kinds of steel; the making of ingots; the mechanical and heat-treatment of steel; and the correlation of structure and properties to intended use. The class also studies and reports upon several local foundries. Mr. Mann and Mr. Haley.

Fire Assaying: 1 S. ½ credit. Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Lectures and recitations. This course deals with the theory of fire assaying as practiced in the laboratory. Mr. Mann.

Fire Assaying: 1 S. Spring. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Laboratory course. The study of assaying is approached from both the theoretical and practical sides. The course is intended to increase the proficiency of the student in thinking, in knowledge, and in manipulative skill. A great variety of ores, furnace products, and metals are worked upon in the laboratory by the best methods. Text: "The Sampling and Assay of the Precious Metals," by Smith. Mr. Mann and Mr. Haley.

Electro-Metallurgy: 1 S. Fall. 3 credits. Seniors in metallurgical engineering. Prerequisite, Electro-Chemistry and Principles of Metallurgy. Lectures and recitations. Lectures are given covering the electro-metallurgical processes that are in use. Efficiency and engineering calculations based on these processes are also given. Mr. Mann.

Metallurgy Problems: 1 S. Fall. 3 credits. Seniors in metallurgical engineering. Prerequisite, Principles of Metallurgy, the Metallurgy of Copper. Lectures and recitations. This course aims to cover the common problems that the metallurgist meets in practice. Mr. Mann.

Physical Metallurgy: 1 S. Spring. 4 credits. Seniors in metallurgical engineering. Prerequisite, Metallurgy of Lead. Lectures, recitations, and laboratory. This course deals with the theoretical and practical considerations that influence the structure and properties of alloys of different types. Mr. Mann.

MINING ENGINEERING AND SURVEYING

PROFESSOR, THEODORE SIMONS. ASSOCIATE PROFESSOR, A. E. ADAMI.

Plane Surveying: 1 S. Spring. 3 credits. Freshmen. Prerequisite, Algebra and Trigonometry. Lectures and recitations. The course in the theory of plane surveying takes up the construction, adjustment, use, and care of surveying instruments, the form of field notes for different methods of surveying, computation of bearings, co-ordinates, elevations, areas, and quantities of material, from data secured in the field, the solution of problems in surveying, and practical uses of surveying instruments on the school grounds. Text: "Plane Surveying," by Tracy. Mr. Adami.

Plane Surveying, Field Work: Summer Field Work, 4 weeks. 2 credits. Deposit, $10.00. Sophomores. Prerequisite, Plane Surveying. During the course in plane surveying the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets; determination of true meridian by solar observation and by observation on Polaris; traverse survey with transit and steel tape; angles by repetition; azimuth and deflection; problems in public land surveying in accordance with Manual Instruction to United States Deputy Surveyors; official survey of mining claims and application for United States patent; returns to consist of letters of transmittal, plat, field notes, and computations, in form of transmission to United States Surveyor General; topographic survey with transit and steel tape; stadia and trigonometric survey; base line triangulation; leveling for profile and contour lines, and for establishment of bench marks; staking out buildings and excavations for foundations, and calculations of quantities to be excavated; survey of ditch or flume line; preliminary and location survey of railroad. Mr. Adami.

Topographic Drawing: 1 S. Fall. 2 credits. Sophomores. Prerequisites, Plane Surveying, Field Work. The work consists of platting on a suitable scale the surveys executed in the field. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps and mills. Additional instruction is given in the construction of contour lines and in the laying out of railroads and wagon roads, dams, reservoirs, flumes, and ditches on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, by cross sections made from contour maps. During the work special attention is given to lettering, titles, borders, and north points, and general neatness in execution. Mr. Adami.

Mine Surveying: 1 S. Spring. 1 credit. Sophomores. Prerequisites, Plane Surveying, Topographical Drawing, and Descriptive and Analytical Geometry. A course of lectures on underground surveying and shaft plumbing, including the mathematical and graphical solution of numerous surveying problems. Mr. Simons.

Mine Surveying, Field Work, and Mapping: Summer Field Work, 2 weeks. 1 S. Fall. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Mine Surveying. During the course in Mine Surveying, carried on at a mine in actual operation, the students are required to execute the following surveys and prepare the necessary field notes: Plumbing the shaft; a complete survey of the underground workings, as well as all important surface features, such as buildings, ore bins, tracks, claim boundaries, and streets. In the class-room all necessary calculations are made for the final platting of the field notes, and a composite map is made showing the underground workings, surface plant, claim lines, and city streets. In addition, a number of sections are made showing the occurrence of the ore bodies, position of shafts, levels, cross-cuts, stopes, and the vertical relation of the ore bodies to the underground workings. Mr. Simons.

Mining: 2 S. Continuous. 5 credits. Juniors. Prerequisite, Mine Surveying. Lectures, drawing, and laboratory. The course in mining takes up the following topics: prospecting, discovery, locating and acquiring title to mining claims, breaking ground by various methods of hand work, rotary and precussion drills, explosives and their uses. supporting excavations by timbering, masonry, and metallic supports. The lectures and recitations are illustrated by drawings, prints, models, and frequent visits to the local mines. While at the mines special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drills, and boring by precussion drills. In the laboratory actual tests on various kinds of drills are given, with a view to determine the air consumption, rate of drilling, efficiency, and cost of operation. In the drawing room the students are taught to make drawings of structures in wood, masonry, and metal, including ore and coal bins, railroad trestles, headframes, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems, with all conditions and requirements, are dictated to the students, and numerous blue prints of actual constructions are on file for reference. Mr. Adami.

Mining: 2 S. Continuous. 4 credits. Seniors. Prerequisites, Junior Mining, Physics, Hydraulics, and Mine Surveying. Lectures and design. A course in air compression, prospecting for placer deposits, exploitation of gold placers by various methods, including hydraulicking and dredging, water supply for hydraulic and other mining operations, reservoirs, dams, ditches, and pipe lines, exploitation of useful minerals by open work and various methods of underground stoping, mine haulage, hoisting, and hoisting machinery and accessories, drainage and pumping, ventilation, natural and artificial, light and sanitary arrangements, commercial mining operations, superintendency and management of mines, selecting and buying samples and machinery, mine economics and mine accounts, examination and reporting on mines and mining enterprises. Mr. Simons.

Ore Dressing: 2 S. Continuous. 8 credits. Seniors. Prerequisite, Mechanics, Junior Mining, Physics, and Calculus. Lectures, design, and laboratory. A study of the physical laws governing the various processes of ore dressing, such as crushing, jigging, free and hindered settling, the principles of screen sizing and hydraulic classification, the construction and operation of typical milling machinery, rolls, grinding mills, jigs, tables, vanners, magnetic separators, flotation processes, and mill accessories, power transmission and water supply for milling operations. The study of design and methods of ore dressing is further carried on at plants visited during the school year and by practical tests in the ore dressing department of the school laboratory. From the design of single structures, the course leads to the design of a complete plant for one or more operations of mining and ore dressing. It is the aim in this course to develop the originality of the student; although the instructor in charge is always on hand to assist, the student is on his own resources as far as possible. He is required to make use of catalogs and reference books to obtain the data necessary for the completion of his problem. Attention is given to the assembling, bills of materials, and the item of costs. The problems are given to the student and discussed in the class-room.

The course in mining and ore-dressing is completed by a two weeks' excursion into districts where mining and ore-dressing methods which do not prevail in the Butte district can be studied. Mr. Simons.

SPANISH

INSTRUCTOR, B. F. THOMAS.

Elementary Spanish: 2 S. Continuous. 6 credits. Elective. Open to all students. Texts: "Spanish Grammar," by Espinosah and Allen, and "Lecturas Facilies," by Wilkons. Mr. Thomas.

Register of Students

1919-1920

SENIOR CLASS

*Cliff, Frank M.	Butte
*DeMordaunt, Paul	Butte
*Hale, Emmet	Butte
*McAuliffe, D. C.	Butte
*Mueller, Ernest	Butte
*Renouard, Edward I., Jr.	Butte
*Rowe, Francis A.	Butte
*Vaupell, C. W.	Butte
*Wilson, Curtis L.	Anaconda

JUNIOR CLASS

*Amberson, Julius	Mandan, N. D.
*Cole, Clancy W.	Butte
Davies, Fred N.	Butte
*Eaves, Lucian, Jr.	Butte
*Emery, Lawrence W.	Butte
*Fredell, C. A.	Anaconda
*Holland, John G., Jr.	Butte
*Kirwan, Gerald M., Jr.	Contact
*McGonigle, Walter L.	Butte
*Merrill, William L.	Butte
O'Brien, Wallace A.	Butte
*Symons, Henry H.	Butte
*Taylor, Maurice H.	Anaconda
*Whealdon, Alfred N.	Portland, Ore.
*Werelius, Walter R.	Ramsey

SOPHOMORE CLASS

*Adelstein, Benjamin	Butte
*Baker, Thomas D.	Butte
Bigelow, Frank O.	Butte
*Bishop, Lester F.	Butte
*Bowlby, Robert H.	Butte
*Brockway, A. Grove	Spokane, Wash.
*Carroll, Walker B.	Butte
*Dougherty, James	Anaconda
*Driscoll, Timothy H.	Butte
*Fisher, Samuel H.	Butte
*Freshman, Walter C.	Butte
Groom, Carl M.	Butte
Heatherly, Sam	Kendall
Judge, Joseph A.	Butte

McDonald, Alex M	Butte
McQuay, Ray	Butte
*MacLellan, Donald D	Butte
*MacMillan, Duncan	Butte
Mathews, Charles S	Butte
Mowbray, Willard W	Anaconda
*Naughten, James J	Butte
*Nuckols, John A	Anaconda
Shea, Edward P	Butte
Tower, William Bruce	Missoula
*Wade, Ralph J	Butte

FRESHMAN CLASS

Bato, W. H	Butte
Borel, Arnold Eugene	Eldred, Pa.
*Charles, Clarence D	Butte
Crowley, Clifford D	Butte
Downey, Melvin H	Butte
Dunstan, James	Butte
*Eaves, William Cady	Butte
Gay, Ingles M	Walkerville
*Gilmore, John J	Butte
Harmon, Charles H	Grass Range
*Harrington, Leonard T	Butte
Healy, Aloysius	Butte
James, John William	Anaconda
Kennedy, William J	Butte
Kramer, Fred B	Butte
Ladic, Sanford W	Butte
*Lee, Wallis H	Glendive
*Leisy, Cecil A	Butte
*McCarthy, Donal F	Anaconda
*McGreal, Charlie C	Butte
*McKenzie, Thomas E	Butte
*McMaster, Patrick D	Butte
McNeil, Charles L	Anaconda
*MacDonald, George D	Butte
MacKay, James H	Mullan, Idaho
*Maloney, William G	Butte
Martin, James E	Butte
*Moran, Aloysius J	Butte
*Murphy, Francis J	Butte
Murphy, William	Butte
*Myers, Walter H	Butte
Osterholm, Victor L	Butte
*Price, William	Red Lodge
*Quinn, Hugh M	Butte
Renouard, Clarence S	Butte

*Robertson, Donald A.	Onalaska, Wash.
*Rudolph, Joseph	Butte
Sahinen, George F.	Butte
*Schwanz, Fred D.	Butte
*Smith, Irwin N.	Butte
*Steadman, Aaron	Butte
*Streibich, Frederick W.	Butte
*Struthers, William A.	Butte
Thompson, Almer J.	Butte
Willson, Fay G.	Virgille
Woodward, Claudia Helen	Butte
*Young, Forest H.	Park City

UNCLASSIFIED STUDENTS

*Blomgren, C. H.	Butte
*Bohanon, Harold J.	Spokane, Wash.
*Elder, Robert A.	Miles City
*Fraser, Garrett A.	Seattle, Wash.
Fregoso, Pablo G.	Guadalajara, Mexico
Hogan, Maybelle	Butte
*Howarth, Vard O.	Richfield, Utah
Keith, Florence	Butte
Kerrigan, Lillie	Butte
*McGovern, Eugene L.	Butte
McGrath, Florence M.	Butte
*Nutting, Haven C.	Thompson Falls
Range, Ruth M.	Butte
*Rooney, Lawrence P.	Spokane, Wash.
*Stanaway, Ray C.	Butte
Struthers, Cecelia E.	Butte
Sultzer, Willa A.	Butte
Thrasher, Willard	Butte

SPECIAL STUDENTS

*Curran, Charles H.	Butte
*Gilbert, Donald C.	Butte
*Grimes, Alden	Butte
Griswold, George G., Jr.	Butte
*Hutloff, Benjamin L.	Butte
Mendenhall, S. A.	Bozeman
*Miller, Edward R.	Highwood
*Murphy, Paul R.	Butte
Nelson, Axel S.	Butte
O'Kelly, William A.	Butte
*Tait, Thomas W.	Howard
Young, Earl B.	Butte

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*Military Scholarship.

Summary of Registration

Seniors	9	
Juniors	15	
Sophomores	25	
Freshmen	47	
Unclassified	18	
Special	12	
		126
Extension Correspondence Students		65
Total		191

Register of Alumni

Adami, Arthur E., 1907 .... Butte, Montana
Associate Professor Mining Engineering, Montana State School of Mines.
Mining Engineer, Montana State Bureau of Mines.

Aline, Peter A., 1915 .... Great Falls, Montana
Chemist, A. C. M. Co.

Andrew, John T., 1912 .... Butte, Montana
Lawyer.

Archibald, George B., 1905 .... Salt Lake City, Utah
Carey Act Inspector, General Land Office.

Balmforth, Alfred J., 1904 .... Bisbee, Arizona

Bassett, Arthur F., 1912 .... Detroit, Michigan
Sales Engineer, Detroit Territory, Motor Bearings Division, Hyatt Roller Bearing Co.

Bender, Louis V., 1903 .... Anaconda, Montana
General Supt., Washoe Reduction Works, A. C. M. Co.

Bovett, C. A., 1907.

Bowden, Malcolm, 1908 .... Butte, Montana
Superintendent, Travona Mine, A. C. M. Co.

Brinton, Owen F., 1905 .... Salt Lake City, Utah
General Manager and Consulting Engineer, Western Utah Copper Co.

Brulo, William .... Helena, Montana
Manager, Loan Dept., Montana Life Insurance Co.

Cannon, Frank D., 1917 .... Butte, Montana
Shift Boss, Berkeley Mine, A. C. M. Co.

Carlisle, Stanley B., 1917.
Deceased.

Cheung, T. C., 1917 .... Hong Kong, China
Coal Mining.

Christian, Otto B., 1912 .... Los Angeles, California

Clinch, R. S., 1911 .... Moctezuma, Sonora, Mexico
Ore Buyer.

Clinch, Walter D., 1912 .... Butte, Montana
Shift Boss, Timber Butte Milling Co.

Cohan, Jesse E., 1912 .... Butte, Montana
Engineering Department, A. C. M. Co.

Cole, Robert J., 1914 .... Butte, Montana
Geologist, Elm Orlu Mining Co.

Collins, Thomas F., 1917 .... Butte, Montana
Shift Boss, Bell and Diamond Mine, A. C. M. Co.

Cooke, Hamilton, Jr., 1912 .... Butte, Montana
In Metallurgical Dept., Timber Butte Mill.

Corey, Clarence R., 1905 .... Seattle, Washington
Assistant Professor of Metallurgy, College of Mines, University of Washington.

Courtney, Edward F., 1919 .... Anaconda, Montana
Assistant Testing Engineer, Washoe Reduction Works, A. C. M. Co.

Crittenden, Zar T., 1913 .... Pontiac, Michigan
Assistant Metallurgist, Oakland Motor Car Co., Division General Motors Corporation.

Cullity, Emmet R., 1912 .... The Pas, Manitoba, Canada
Mining Engineer, Flin Flon Syndicate, Exploration in The Pas District, Manitoba.

Curran, Francis R., 1916....................Butte, Montana
Mine Sampler, Elm Orlu Mining Co.

Dobson, Chris G., 1913....................Seattle, Washington
Instructor, Department Civil Engineering, University of Washington.

Dugan, John F., 1906....................Butte, Montana
Foreman, Nettie Mine, A. C. M. Co.

Duling, J. F., 1904.

Duthie, John M., 1905....................Forsyth, Montana
Private Engineering Practice. Land Classification.

Elford, Basil E., 1905....................Anaconda, Montana

Ellis, William H., 1908....................Billings, Montana
Construction Engineer.

Engel, A. L., 1919....................Great Falls, Montana
Chemist, Reduction Plant, A. C. M. Co.

Evans, James R., 1909..........Tshikapa, Congo, Belge, West Africa
Mining Engineer with Societe Internationale Forestiere et Minere du Congo.

Feeney, Charles M., 1906.
Deceased.

Foote, Frank A., 1908..........Kasai, Tshikapa, Congo Belge, West Africa
Mining Engineer.

Fowler, George M., 1912....................Butte, Montana
Geologist, A. C. M. Co.

Freshman, Herman A., 1917....................Butte, Montana
Mining Engineer.

Gaethke, Fred P., 1917....................Butte, Montana
Safety and Ventilation Engineer, East Colusa Mine, A. C. M. Co.

Gidel, Murl H., 1912....................Butte, Montana
Geologist, A. C. M. Co.

Gieser, H. S., 1906....................Anaconda, Montana
Concentrating Engineer, A. C. M. Co.

Gilham, Ralph, 1909....................Townsend, Montana

Giovanetti, Ettore, 1912....................Butte, Montana
Instructor, Butte Business College.

Goodell, Luther T., 1915....................Seattle, Washington
With Times Publishing Co.

Grunert, August, 1910....................Butte, Montana
Sampling Dept., Butte and Superior Mining Co.

Grupe, Charles W., 1912.

Haines, Peter A., 1909....................Rivermines, Missouri
Superintendent, Doe Run Lead Co.

Hanson, Wilbur W., 1913....................Butte, Montana
Safety Inspector, A. C. M. Co.

Hill, W. J., 1916..........Minas Tecolotes y Anexas, Santa Barbara, Chihuahua, Mexico
Mining Engineering and Geology.

Hogan, Eugene, 1916....................Butte, Montana
Mining and Safety Engineer, Poulin Mine, A. C. M. Co.

Hunt, John E., 1915....................Butte, Montana
In Testing Dept., Timber Butte Milling Co.

Ireland, Arthur J., 1904.
Deceased.

Jensen, Walter H., 1910....................Great Falls, Montana
Secretary-Treasurer, Montana Brewing Company.

Johns, John W., 1906....................Marysville, Montana
Superintendent Shannon Mines, Barnes-King Development Co.

Johnstone, J. Clarke, 1909..Nelson, B. C., Canada
General Superintendent, Vincent Development Co.

Kane, Edward G., 1909..Butte, Montana
Mine Foreman, Bell-Diamond Mines, A. C. M. Co.

Kane, Louis M., 1906.
Deceased.

Ketcham, S. H., 1908..Missoula, Montana
Engineer, Private Practice.

Kirby, Kenneth P., 1909..Butte, Montana
Mining Engineer, Anaconda Mine, A. C. M. Co.

Kuphal, Henry E., 1904.

Lind, A. Leslie, 1916..Butte, Montana
With Butte Stove Repair Co., M. C. Lind & Sons, Props.

Ling, Tao, 1917..Toungas, Burma, India
Mining Engineer, Zacchrene Stone Quarries.

Lomas, E. Percy, 1908..Butte, Montana
President, Butte East Slope Mining Co.

Loughran, David L., 1918..Butte, Montana
Assistant County Surveyor.

Loughran, M. J., 1909..Butte, Montana
County Surveyor, Silver Bow County, Montana.

Lowry, T. M., Jr., 1909..Sacramento, California

Lyden, Joseph P., 1914..Butte, Montana
Geologist, A. C. M. Co.

Lyon, Thomas T., Jr..Butte, Montana
Chief Sampler, A. C. M. Co.

McCool, Edward J., 1913..Butte, Montana
Safety and Ventilation Engineer, A. C. M. Co.

McCracken, R. H., 1907..Philipsburg, Montana
Engineer, Philipsburg Mining Co.

McElvenny, L. T., 1911..Butte, Montana
Assistant City Engineer, Butte.

McGee, John, 1904..Tonopah, Nevada
General Manager, Great Western Con. Mining Co.
General Manager, Water Company of Tonopah.

McLaughlin, William D., 1908..Butte, Montana
Surveyor, Tramway Mine, A. C. M. Co.

McMahon, Brandon P., 1914..Butte, Montana
Shift Boss, A. C. M. Co.

Mackel, Louis C., 1905..Santa Fe, New Mexico
Mineral Examiner, General Land Office.

MacPherson, Frank H., 1914..Butte, Montana
Mining Engineer, A. C. M. Co.

MacRae, L. D., 1904..Nacozari, Sonora, Mexico
Engineer, Moctezuma Copper Co.

Malloy, Emmet E..Butte, Montana
Emmet E. Malloy & Co., Land Classifiers and Appraisers.

Manwaring, Joseph H., 1913..Butte, Montana
Factory Engineer, Berger Steel Co.

Mason, Veyne V., 1916..Butte, Montana
Boss Trammer, Tramway Mine, A. C. M. Co.

Meiklejohn, Archie B., 1908..Los Angeles, California
Distribution Accountant, Southern California Edison Co.

Milkwilk, Clifford F., 1919..Anaconda, Montana
Assistant Testing Engineer, A. C. M. Co.

Murphy, James K., 1911..Anaconda, Montana
Asst. Supt., Washoe Reduction Works, A. C. M. Co.

Murphy, Joseph G., 1914.

Nelson, A. S., 1918........Leadwood, Missouri
Chemist, St. Joseph Lead Company.

Newton, Claude O., 1919........Homestead, Oregon
Shift Boss, Homestead Iron Dyke Mines Co., Inc.

Newton, Lucian, 1913........Shoupe, Idaho
Superintendent, Kentuck Mining Co.

Norton, John E., 1917........New York City
Student Columbia University.

O'Brien, Albert, 1908........Butte, Montana
Mining Engineer.

O'Connor, C. H., 1911........Butte, Montana
In Testing Department, Timber Butte Milling Co.

Parker, W. Howard, 1917.
Deceased.

Patten, Earl B., 1908........Philipsburg, Montana
Mining Engineer, Private Practice.
County Surveyor, Granite County.

Pauly, P. L., 1904........Butte, Montana
Draftsman, Timber Butte Milling Co.

Peter, Ira B., 1909........Butte, Montana
Ventilation Engineer, A. C. M. Co.

Peterson, P. E., 1911........Anyox, B. C., Canada
Supt. of Concentration, Granby Cons. Mining, Smelting and Power Co., Lt'd.

Petritz, William E., 1918........Butte, Montana
Shift Boss, Reins Mine, A. C. M. Co.

Pierce, Wilbur C., 1919........Great Falls, Montana
Chemist in General Laboratory, A. C. M. Co.

Pierse, Edwin A., 1913........Great Falls, Montana
Pierse Auto Company.

Pilger, Theodore, 1912........West Allis, Wisconsin
Foreign Sales Engineer, Allis Chalmers M'f'g. Co.

Pratt, A. F., 1913........Portland, Oregon
Lawyer.

Pratt, Paul D., 1905........Helena, Montana
General Contracting Business.

Proctor, M. D., 1908........Truly, Montana
McNair & Proctor Ranch Company.

Proctor, I. O., 1908........Butte, Montana
Mill Foreman, Timber Butte Milling Co.

Reardon, D. J., 1907........Butte, Montana
Member of firm of Medin & Co., General Contractors.

Reber, Bert A., 1915........Neihart, Montana
Mining Engineer for Cascade Silver Mines and Mills, Neihart Silver Mines, and Neihart Cons. Silver Mining Co.
Leasing at Moulton Mine.

Reese, Mrs. Clara Clark, 1904........Los Angeles, California

Reid, Milton A., 1913........Butte, Montana
Chief Chemist, Washoe Sampler.

Roach, James, 1911.
Deceased.

Schaefer, W. A., 1907.
Deceased.

Schiffner, O. E., 1908........Oakland, California
Foreman, Moore Shipbuilding Co.

Sheedy, John W., 1915........Helena, Montana

Shields, E. F., 1911........Philipsburg, Montana
General Manager Scratch Awl M. & D. Co.

Sparks, Karl T., 1917........Butte, Montana
Mining Engineer, U. S. Bureau of Mines.

Steele, Chester H., 1916........Butte, Montana
Geologist, A. C. M. Co.

Stevenson, Isabel Little, 1904........Richmond, Virginia
Bookkeeper, Discount Dept., Federal Reserve Bank.

Stevenson, L. C., 1905.
Deceased.

Stockett, Norman A., 1909........Bonne Terre, Missouri
Engineering Dept., St. Joseph Lead Co.

Strang, Willis B., 1916........Musselshell, Montana
Mining Engineer and Top Foreman, Star Coal Company.

Stuewe, William, Jr........Sopkane, Washington
Sales and Structural Engineer, Minneapolis Steel and Machinery Co.

Sultzer, H. Duke, 1911........Butte, Montana
Ventilation and Safety Engineer, Tramway Mine, A. C. M. Co.

Tallant, Harry S., 1904........Palma Sola, Florida
Farmer.

Ternouth, Blaine, 1914.

Thrasher, Willard, 1918........Butte, Montana
Geologist, North Butte Mining Company.

Tout, Charles, 1911........Butte, Montana
Burgess & Tout, Mining Engineers.

Tseo, G. B., 1917........Nanchong, Kiangse, China
Mining Director of the Industrial and Mining Bureau of Kiangse.

Van Gundy, Jay E., 1905........Anaconda, Montana
Engineer, Washoe Smelter, A. C. M. Co.

Villars, Jesse R., 1908........Kalma, Montana
Ranchman.

Vivian, George, 1917........Butte, Montana
Sampler, A. C. M. Co.

Walton, Lee M., 1908........Great Falls, Montana
Manager, Wardrobe Company.

Warfield, Hershel, 1906........Los Angeles, California
Dealing in Securities.

Watson, Robert M., 1908.
Deceased.

Wiegenstein, Henry J., 1909........Butte, Montana
Safety and Ventilation Engineer, A. C. M. Co.

Wilkinson, Thomas, 1917........Butte, Montana
Asst. Foreman, Fire Filling, Reins Mine, A. C. M. Co.

Williams, Paul K., 1912........Trail, B. C., Canada
Construction Engineer, Consolidated Mining and Smelting Co.

Wilson, T. Bert, 1906........Goldendale, Washington
Manager, Goldendale Garage.

Wong, Samuel C., 1916........Tet-tau-wau, Hupeh, China
Mining Engineer, Tayeh Iron Mines.

Woodworth, Guy T., 1915........Great Falls, Montana
Leasing. Neihart, Montana.

Wren, Andrew A., 1908........Patagonia, Arizona
Supt., Patagonia Superior Copper Co.

Young, Arthur B., 1906........Canille, Arizona
Mining Engineer.

Young, S. A., 1906..Astoria, Oregon
Metal Mining Engineer, U. S. Government.
Young, William A., 1909..Maiden, Montana
Lessee Maginnis Mine.
Zentner, Arthur A., 1911..Great Falls, Montana
Research Engineer, Zinc Plant, A. C. M. Co.

Register of Alumni by Classes

1903

L. V. Bender.

1904

A. J. Balmforth, Clara Clark (Reese), J. F. Duhling, Arthur L. Irelan, Henry E. Kuphal, Isabel Little (Stevenson), L. D. MacRae, John McGee, P. L. Pauley, H. S. Tallant.

1905

George Archibald, O. F. Brinton, Clarence R. Corey, J. M. Duthie, Basil Elford, L. C. Mackel, P. D. Pratt, L. C. Stevenson, Jay Van Gundy.

1906

J. F. Dugan, Charles W. Feeney, Herbert S. Geiser, John W. Johns, Louis N. Kane, Hershel J. Warfield, Bert T. Wilson, S. A. Young, Arthur B. Young.

1907

Arthur E. Adami, Clifford A. Bovett, Ralston H. McCracken, Daniel Reardon, W. A. Schafer.

1908

Malcolm Bowden, Willis H. Ellis, Frank A. Foote, S. H. Ketcham, E. P. Lomas, T. M. Lowry, William D. McLaughlin, Archie B. Meiklejohn, Albert O'Brien, Earle B. Patten, I. O. Proctor, M. D. Proctor, Otto E. Schiffner, Jesse R. Villars, Lee M. Walton, A. A. Wren.

1909

William Brulo, James R. Evans, Ralph Gilham, Peter A. Haines, J. Clark Johnstone, Edward G. Kane, Kenneth P. Kirby, Michael Loughran, Emmett E. Malloy, Ira B. Peters, Norman A. Stockett, Henry J. Wiegenstein, William A. Young.

1910

August Grunert, Walter H. Jensen, William Stuewe, Jr.

1911

R. S. Clinch, L. T. McElvenny, James K. Murphy, C. H. O'Connor, P. E. Peterson, James Roach, E. Floyd Shields, H. D. Sultzer, Charles Tout, Arthur A. Zentner.

1912

J. T. Andrew, Arthur F. Bassett, Otto B. Christian, Walter D. Clinch, Jesse E. Cohan, Hamilton Cooke, Jr., Emmet R. Cullity, Geo. M. Fowler, Murl H. Gidel, Ettore Giovanetti, Charles Grupe, Theo. F. Pilger, Paul K. Williams.

1913

Zar T. Crittenden, Chris G. Dobson, Wilbur W. Hanson, Edw. J. McCool, Joe H. Manwaring, Lucian Newton, Edwin A. Pierse, A. F. Pratt, Milton A. Reid.

1914

Robt. J. Cole, Joseph P. Lyden, Brandon McMahon, Frank H. MacPherson, Joseph G. Murphy, Blaine Ternouth.

1915

Peter A. Aline, Luther T. Goodell, John E. Hunt, Bert A. Reber, John W. Sheedy, Robert A. Watson, Guy T. Woodworth.

1916

F. R. Curran, William J. Hill, Eugene Hogan, A. Leslie Lind, Thomas T. Lyon, Jr., Veyne V. Mason, Chester H. Steele, Willis B. Strang, S. A. Wong.

1917

Frank D. Cannon, Stanley B. Carlisle, T. C. Cheung, Thomas F. Collins, Herman Freshman, Fred P. Gaethke, Tao Ling, John E. Norton, Howard Parker, Karl T. Sparks, G. B. Tseo, George F. Vivian, Thomas Wilkinson.

1918

David E. Loughran, A. S. Nelson, William E. Petritz, Willard Thrasher.

1919

Edward F. Courtney, A. L. Engel, Clifford F. Milkwick, Claude O. Newton, Wilbur C. Pierce.

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PUBLICATIONS *of* THE UNIVERSITY *of* MONTANA

Copies of the several series of the University of Montana Bulletin, of the University of Montana Circular, and of the University of Montana Syllabi, may be obtained upon request from the president of the particular institution concerned. Copies of the University of Montana studies and of the general series of the Bulletin and of the Circular will be furnished from the office of the chancellor of the University.

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Each series of the Bulletin is issued quarterly, and contains annual reports, catalogues, etc.

1. General Series (Office of the Chancellor).
2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
4. Experiment Station Series.
5. Normal College Series.
6. School of Mines Series.
7. Alumni Series.

II. UNIVERSITY OF MONTANA CIRCULAR

Each series of the Circular is issued at irregular intervals and contains various special announcements.

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2. State University Series.
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Each series contains outlines and Syllabi of certain courses of instruction given at the several institutions.

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3. Normal College Series.
4. School of Mines Series.

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Each series deals with topics of current importance regarding the affairs of the university and its several institutions.

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2. State University Series.
3. College of Agriculture and Mechanic Arts Series.
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5. School of Mines Series.

BUTTE MINER CO., PRINTERS

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UNIVERSITY OF MONTANA BULLETIN
SCHOOL OF MINES SERIES NO. 4

STATE SCHOOL OF MINES

TWENTY-FIRST ANNUAL CATALOGUE

1920-1921

ANNOUNCEMENTS FOR
1921-1922

BUTTE, MONTANA
JULY, 1921

THE UNIVERSITY OF MONTANA

Edward C. Elliott, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913):

The general control and supervision of the University are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

MONTANA STATE BOARD OF EDUCATION

J. M. DIXON, Governor	Ex-officio, President
W. D. RANKIN, Attorney General	Ex-officio
MAY TRUMPER, Superintendent of Public Instruction	Ex-officio, Secretary

A. J. VIOLETTE	(1922)	WHITFIELD SPAIN	(1924)
JUDGE SIDNEY SANNER	(1922)	J. W. FREEMAN	(1924)
C. H. FOOT	(1923)	JOHN DIETRICH	(1925)
R. C. LINE	(1923)	FRANK ELIEL	(1925)

The State University, Missoula

Established February 17, 1893, and Consisting of

- The College of Arts and Sciences
- The School of Law
- The School of Pharmacy
- The School of Forestry
- The School of Journalism
- The School of Music
- The School of Education
- The School of Business Administration
- The Summer Quarter
- The Biological Station (Flathead Lake)
- The Public Service Division
- Special War Courses—
    - Military Service Course (one year)
    - Nurses' Preparatory Course (one year)
    - Office Training Course (one year)
- The Graduate Division

Edward O. Sisson, President

The State College of Agriculture and Mechanic Arts, Bozeman

Established February 17, 1893, and Consisting of

- The College of Agriculture
- The College of Engineering
- The College of Applied Science
- The College of Household and Industrial Arts
- Courses for Vocational Teachers
- The School of Music
- The Summer Quarter
- The Agricultural Experiment Station
- The Agricultural Extension Service
- The Secondary Schools—
    - Home Economics
    - Mechanic Arts
    - Agriculture
- Special War Courses—
    - Military Service Course (one year)
    - Nurses' Preparatory Course (one year)
    - Office Training Course (one year)

Alfred Atkinson, President

The State School of Mines, Butte

Established February 17, 1893

The State Bureau of Mines and Metallurgy

Charles H. Clapp, President

The State Normal College, Dillon

Established February 23, 1893, and Consisting of

- The Teachers' Certificate Course
- The Three-Year Course
- The Four-Year Course
- The Rural Teachers' Course
- The Course for Supervisors

Sheldon L. Davis, President

For publications and detailed information concerning the different schools and colleges address the president of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA BULLETIN

SCHOOL OF MINES SERIES NO. 4

STATE SCHOOL OF MINES

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School Calendar 1921-1922

1921

SUMMER WORK

June 6, Monday, Mine Surveying begins.
June 18, Saturday, Mine Surveying ends.
August 15, Monday, Field Work in Plane Surveying begins
August 22, Monday, Field Work in Geology begins.
September 10, Saturday, Summer Field Work ends.

FIRST SEMESTER

September 12, Monday, First Semester begins.
November 24, Thursday, Thanksgiving Day, holiday.
December 17, Saturday, Christmas Recess begins.

1922

January 2, Monday, Christmas Recess ends.
January 27, Friday, First Semester ends.

SECOND SEMESTER

January 30, Monday, Second Semester begins.
May 30, Tuesday, Memorial Day, holiday.
June 2, Friday, Commencement Day, Second Semester ends.

SUMMER WORK

June 5, Monday, Mine Surveying begins.
June 17, Saturday, Mine Surveying ends.
August 21, Monday, Field Work in Plane Surveying begins.
August 28, Monday, Field Work in Geology begins.
September 16, Saturday, Summer Field Work ends.
September 18, Monday, First Semester begins.

Official Directory

EXECUTIVE BOARD

CHARLES H. CLAPP (ex-officio) Chairman	Butte
RENO H. SALES	Butte
CHARLES BOCKING	Butte

ADMINISTRATIVE OFFICERS

EDWARD C. ELLIOTT, Ph. D.	Chancellor, University of Montana
CHARLES H. CLAPP, Ph. D.	President
GEORGE W. CRAVEN, B. S.	Vice-President
CHARLOTTE RUSSELL	Registrar and Librarian

THE FACULTY

Professors

CHARLES H. CLAPP	President and Professor of Geology and Mineralogy	Ph. D., Massachusetts Institute of Technology
GEORGE W. CRAVEN	Vice-President and Professor of Mechanics and Mathematics	B. S., Massachusetts Institute of Technology
LESTER J. HARTZELL	Professor of Chemistry	B. S., Colorado School of Mines
HORACE T. MANN	Professor of Metallurgy	B. S. in M. E., School of Mines, University of Missouri M. S., School of Mines, University of Missouri E. M., School of Mines, University of Missouri
THEODORE SIMONS	Professor of Mining Engineering	E. M. and C. E., Royal Polytechnicum, Munich

Associate Professors

ARTHUR E. ADAMI	Associate Professor of Mining Engineering	E. M., Montana State School of Mines
ALFRED E. KOENIG	Associate Professor of Chemistry	B. A., Macalester College M. A., University of Wisconsin Ph. D., University of Wisconsin
WALTER T. SCOTT	Associate Professor of English and Economics Director of Student Activities	A. B., Westminster College of Pennsylvaniia A. M., Harvard University

Assistant Professors

E. RALPH BOWERSOX	Assistant Professor of Physics and Mathematics	B. S. Coe College B. E. E., University of Iowa
GERALD S. LAMBERT	Assistant Professor of Geology	B. S., School of Mines, University of Utah

Instructors

B. E. THOMAS	Spanish	Platville State Normal Collegee, Wisconsin U. S. Government Interpreter in Spanish, 1900-1910
CHESTER M. PITTSER	Coach of Athletics	Colorado School of Mines

Assistants

M. F. HALEY	Assistant in Mill Work

University of Montana

An Act of Congress, approved February 18, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana, in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined, and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer, whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1, 1916.

At the general elections in November, 1920, the voters of the State, by a large majority, enacted, through the popular initiative, two measures for the financial support and development of the University of Montana. The first of these measures levies a tax of one and one-half mills on all the taxable property in the state annually for ten years for the maintenance of the University of Montana; the second provides for a State bond issue, from the proceeds of which three and three-quarters million dollars become available for the erection and equipment of buildings at the several institutions of the University of Montana.

State School of Mines

The establishment of the State School of Mines, in Butte, was supervised by a commission appointed in 1895, consisting of F. E. Sargent, John Gillie, W. W. Dixon, J. H. Leyson, and C. W. Goodale. The lands of the School of Mines were used as a basis for the issue of bonds amounting to $120,000.00, and in 1896 the erection of the main building was begun. An additional appropriation of $26,300.00 was made in 1899 for equipment and maintenance. The school actually opened September 11, 1900, and the first class graduated in June, 1903.

The proceeds from the sale of the lands of the School of Mines have gone into a permanent fund, the interest from which, together with the rentals from unsold lands, has provided the school in recent years with most of its ordinary operating and capital expenditures. In 1907, $50,000.00 was appropriated for a new heating plant and mill building, and in 1910, $15,000.00 was appropriated for a gymnasium.

Nathan R. Leonard, Professor of Mathematics, was the first President of the institution. He was succeeded in 1906 by Charles H. Bowman, Professor of Mathematics, who had been connected with the school since its beginning. In 1918, President Bowman was granted a year's leave of absence, and Charles H. Clapp, Professor of Geology and Mineralogy, was appointed Acting President. Upon President Bowman's resignation in 1919, Professor Clapp became President.

PURPOSE AND SCOPE

The School of Mines has strictly confined itself to the preparation of young men for the mining profession, and by so doing has maintained a very high standard in this field. Before the war ninety per cent. of its graduates were engaged in engineering work, very largely in Mining Engineering, and moreover, many of its graduates hold positions of great responsibility. Although the distinction between a purely vocational school and an engineering college has always been kept clearly in mind, the school has given its students a practical knowledge of mining subjects, as well as a thorough education in theoretical principles. The fundamental subjects for all forms of engineering are given and special emphasis is laid upon the three main branches of mining—geology, mining and milling, and metallurgy.

LOCATION AND SURROUNDINGS

The State School of Mines is located just inside the western city limits of Butte. The site, on the southern bench of Big Butte, the extinct volcano which dominates the city, and from which the city takes its name, was donated by certain public-spirited citizens. It is easily accessible, since the street cars run within two blocks. The location is most commanding, and the view from the grounds overlooks the city, mines, and smelters, as well as the mountains which form the Continental Divide, and which surround the valley in which the city is situated on the east and south.

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city by the leading financiers and mining men of this country and Europe have given this locality such publicity that no one needs to be told of its leading position in the mining world.

In Butte are to be found, not only some of the largest copper and zinc mines in the world, but great mills and reduction plants. These are being continually enlarged and improved to meet the demands of greater industry. In addition, Butte is the site of other great engineering enterprises, and in few other places is there such an assemblage of machine shops, factories, and power plants as are to be found in the vicinity of the school. The city is, therefore, especially well fitted to meet the needs of a mining school.

In a very important sense all of these plants are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of the mining and engineering industry and are thoroughly conversant with the details of the work.

BUILDINGS

The main building, erected during 1895 to 1897, is a four-story pressed brick building. It measures one hundred and eighteen feet by ninety-four feet, and contains 37,000 square feet of floor space. In the basement are the chemical, metallurgical, and mechanical testing laboratories. The next two floors contain the recitation rooms, drafting rooms, mineralogy laboratory, and library. The fourth floor is devoted chiefly to museums, which contain extensive collections of minerals, ores, and mine models. In addition, there is also on this floor a petrograph laboratory and a blue print room.

In the rear of the main building is the mill building, completed in 1908. This building measures seventy feet by one hundred and ten feet. It contains the steam and electric power plant which heats the buildings and supplies power to the mill and laboratories. The mill is equipped to handle large quantities of ore conveniently, and affords treatment of ores by most of the standard processses now in practice.

The gymnasium building, to the north of the main building, was erected in 1910. It measures eighty-seven feet by fifty feet and contains a large gymnasium hall seventy feet by forty-five feet. At one end of the gymnasium is a balcony with a seating capacity for one hundred. The hall itself is used on special occasions as a general auditorium. Connected with the gymnasium are two parlors, a dressing room, and in the basement are the shower baths.

A new chemistry and metallurgical building is in course of erection and will be ready for occupation during the year 1921-1922. When complete it will cost $200,000.00 and will be thoroughly well equipped for its purposes.

The development program for the School of Mines has in prospect for the next few years the erection of an engineering building, a new gymnasium, and an administration hall and library, the remodeling of the present mill building, and the grading and equipping with seats of a new athletic field. Funds for this will come largely from the bond issue voted by the people of the state at the general election in November, 1920.

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of Montana. The total sum invested for this purpose now amounts to $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School.

Department of Mathematics

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor of the Main building, and has all the apparatus necessary for teaching the subjects required.

Department of Mechanics

The department of mechanics occupies three rooms on the first floor of the Main building. The lecture room has a seating capacity of forty persons and is provided with the modern lecture room conveniences. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound, and light. The physics laboratory is housed temporarily in the old S. A. T. C. barracks building, and is equipped with the necessary heavy tables and apparatus for the measurements of density, elasticity, force of gravity, latent heats of fusion and evaporation, mechanical equivalents of heat and light, and electricity.

Mechanics Laboratory

The mechanics laboratory is located in the basement of the Main building and in the Mill building. Its equipment includes electric motors, direct and alternating current dynamos, a mercury arc rectifier, a 50 K.W. generator, a complete switchboard, many instruments used in electrical work, two 80-horsepower boilers and a 75-horsepower high-speed engine illustrating steam power, and an air compressor. There are also a 100,000-pound Olson machine with accessories for tensile, compression, and shearing tests, and a Fairbanks, Morse & Co. outfit for cement tests, as well as apparatus for other tests. A small shop fitted with metal-working machines and a blacksmith shop complete the laboratory.

Department of Chemistry

A great part of the basement floor of the Main building, together with a lecture room on the first floor, has been devoted to the use of the department of chemistry. Included in this arrangement are a qualitative and quantitative analysis laboratory, two special laboratories, a metallurgical laboratory, a store room, a dispensary where the prepared tests for students are kept, and a dark room for photographic work, spectrum analysis, and making blue-prints and lantern slides.

Department of Metallurgy

An assay laboratory and a metallurgical laboratory comprise the main equipment for the department of metallurgy. The assay laboratory is situated on the basement floor of the Main building and has six coal assay furnaces, two gas assay furnaces, gasoline and electrical furnaces for special work, a gas retort and melting furnace, cyanide outfits, and a calcining furnace. Adjoining is a pulp room. Also there is a crusher room provided with a Gates crusher and a Low crusher, a grinder, a pulverizer, a bucking board, and other necessary equipment. Copper, lead, gold, and silver ores are easily assayed here.

The metallurgical laboratory is located in the Mill building, about one-third of which is used for this purpose, while the rest is given over to ore dressing, the central heating plant, and the motor and dynamo room. The laboratory contains a cyanide plant which can handle ore in five-ton lots, a mechanically rabbled Wedge furnace used as a reverberatory or muffler furnace in roasting ores in one-ton lots, and a complete laboratory size Dwight-Lloyd sintering machine.

Mining and Ore Dressing

Two lecture and drawing rooms and an office and store room are provided in the Main building for instruction in mining and ore dressing. The equipment includes all the varied instruments used in practical surveying, both for field and mine work, in sufficient number for student use. Large collections of blue prints, the finest college collection of mine models in the United States, ores in various stages, and bulletins on mining, milling, and smelting are also at the disposal of students.

The ore-dressing laboratory is in the Mill building, and is so arranged that complete tests on a commercial scale can be made on various kinds of ore. The mill includes a crusher, rolls, belt elevators, trommels, screens, an Evans jig and a Hartz jig, a Huntington mill, a Wilfley table, a Deister-Overstrom concentrator, a Deister concentrator slimer, a Frue vanner, a Dings magnetic separator, a three-stamp mill, and such accessories as classifiers, settling tanks, and centrifugal and water pumps. There is also a miniature testing plant which will handle ore in quantities up to four pounds.

Department of Geology and Mineralogy

This department occupies a lecture room, a mineralogical laboratory, and an office on the second floor of the Main building and two museum rooms, a petrographic laboratory, and a storage room on the third floor. An unusually large and complete collection of minerals is maintained, part as student hand specimens and part under glass for observation only. All told, the museum contains well over ten thousand specimens, being especially well supplied with samples from Montana, but also having rocks, minerals, and fossils from all over the world. An extensive collection of real and model chrystals, of maps and charts, and of mine models, the last named used originally in mine litigation in Butte, are employed in class room teaching. The mineralogical and petrographic laboratories contain the apparatus necessary for making tests on rocks, including grinding lathes, petrographic microscopes, cameras, and other instruments and materials too numerous to mention. The department also has on hand all the necessary instruments for field work and owns three complete camping outfits.

THE LIBRARY

Charlotte Russell, Librarian

The library is located on the second floor of the Main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers, with its alcoves, a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others, is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast, and Geodetic Surveys; Reports on Forestry, Forest Reserves and Irrigation; of the Naval Observatories, Engineering Corps, and Bureau of Mines. Besides these, the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the most important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound, and thus furnish, in permanent form, more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and the periodical issues of other colleges.

EXPENSES OF STUDENTS

FEES AND DEPOSITS

By the Act establishing the School of Mines, no charge of tuition is to be made where the student is a bona fide resident of Montana. Students from other states or countries will pay a tuition fee of $25.00 per semester, or $50.00 a year.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

By vote of the student body a student activity fee of $10.00 is asked from each student who registers. The proceeds from this fee are used as the necessary financial guarantee for athletics. In return for this payment, the student will be admitted free to all contests held under the direction of the student body.

To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each student is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is the list of deposits that are required:

Freshman Year

General Chemistry	$15.00

Sophomore Year

Plane Surveying	$10.00
Quantitative and Qualitative Analysis	15.00

Junior Year

Mine Surveying	$10.00
Assaying, Laboratory	10.00
Mineralogy	10.00
Electro and Physical Chemistry	10.00

Senior Year

Metallurgy	$10.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

BOARD AND ROOM

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or vicinity, and at such places as are approved by the faculty. The expense for board and lodging is not higher than in other important cities of the west. Good board can be secured at $30.00 to $35.00 per month, while the cost of a good room, large enough for two persons, and including light and heat, will be from $15.00 to $25.00 per month, according to the location and the furnishings. Cost of text-books average about $25.00 a year. Freshmen will also need a set of drawing instruments, which cost approximately $20.00. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as are found here.

RAILROAD FARE REFUNDS

In accordance with the provisions of Chapter 123, of the Session Laws of 1917, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round-trip between his Montana home and any institution of the University of Montana once each year, will be refunded. No war tax paid by any student will be refunded under any circumstances whatever.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance. This must include at least fifteen units of work. A unit is the amount of work required by the successful completion of one subject pursued for a school year of not less than thirty-six weeks, with five recitations per week, each recitation period being not less than forty-five minutes each. Two periods of laboratory, shop, or drawing work count as one recitation. The required units must include three units in English composition and literature, one in American history and government, one in physics, and three in mathematics distributed between algebra and plane and solid geometry.

Graduates of any Montana high school or academy fully accredited by the State Board of Education, or of any high school or academy in another state accredited by the North Central Association, are admitted to regular standing by the presentation of an official certificate of graduation.

Graduates of any other secondary schools outside of Montana are admitted on the presentation of an official certificate of graduation, if the school maintains, on the basis of regular inspection, accredited relationship with the state university or other university within the state included in the membership of the Association of American Universities.

Any other persons must, in order to be admitted to regular standing, pass a satisfactory examination on not less than fifteen* units of secondary school work; provided, that any graduate of a Montana high school accredited by the State Board of Education for the work of only one, two, or three years, may receive entrance credit without examination upon such work as has been successfully completed in such accredited courses as shown by official certificates.

Those who expect to take entrance examinations must notify the Registrar in advance, stating what subjects they desire to offer by examination. For the academic year 1921-1922 the examination days are September 12 and January 18.

ADMISSION BY TRANSFER FROM OTHER COLLEGES AND UNIVERSITIES

Students entering from other colleges, universities, or schools of mines must bring certificates of honorable dismissal. Upon presentation of proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

CONDITIONAL ADMISSION

The entrance requirement of graduation from a four years accredited high school course, including at least fifteen units of credit, may be modified in individual cases by permitting the conditional admission of a student if he has at least fifteen entrance units and has been in regular attendance in a fully accredited high school for four years. To acquire regular standing such a student must present a total of sixteen entrance units. He must make up the number lacking in one year from the date of his first registration.

SPECIAL STUDENTS

Students twenty-one years of age or over, not candidates for degrees, may be admitted without the usual entrance units as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired. Special students may acquire status as regular students upon complying with the rules applicable to such cases.

HIGH SCHOOL HONOR SCHOLARSHIPS

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana, it is the declared policy of the State Board of Education to provide for the awarding of scholarships to be known as High School Honor Scholarships to graduates of the accredited public high schools of the State.

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*These fifteen units must include three units of English composition and literature and one unit of American history and government. No less than one full unit in any subject will be accepted, and a student offering foreign language as a part of his preparation must present at least two units in one language.

The principal of each fully accredited high school in the State may nominate from each year's graduating class from one to four members, depending upon the size of the class (but not more than two for any institution), to be the recipients of high school honor scholarships. These scholarships exempt the holders from the payment of the customary fees in any of the institutions of the University of Montana. Blanks for the nomination of scholars, with detailed statement of conditions, will be furnished to the principals.

AGRICULTURAL CLUB SCHOLARSHIPS

Upon notice from the State Leader of Boys' and Girls' Agricultural Clubs of the awards of the annual club contests, the Chancellor will authorize the issuance of Agricultural Club Scholarships to the winners of first place in any agricultural club contests in any County in Montana, and to winners of first, second, and third places in the State Agricultural Club contest. These scholarships exempt the holders from the payment of the customary fees in any of the institutions of the University of Montana.

CREDIT FOR WAR SERVICE

Credits toward the degrees of the college will be granted for definite and measurable attainments of mind resulting from service in the army and navy of the United States. The number of credits allowed for military service will be determined by the instructor in the branch in which application for credits is made, subject to approval of the committee on military credit and advance standing. Application for war service credits must be made by the student not later than twelve months after his discharge from service.

ADMISSION AS "WAR SPECIALS"

All students who have been in the military service may be admitted as "War Specials," regardless of high school graduation, upon the presentation of satisfactory evidence that they can carry the work successfully. "War Specials" may acquire status as regular students and become candidates for degrees after carrying one full year's work successfully and upon complying with the rules of graduation.

REQUIREMENTS FOR GRADUATION

The School confers the degree of Mining Engineer upon those who have completed the course as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

MISCELLANEOUS INFORMATION

SCHOLARSHIP AND CONDUCT

The School of Mines requires all its students to conform to the usual standards of society and law-abiding citizenship, and to manifest a serious purpose by maintaining satisfactory standing in the courses which they undertake. No student will be permitted to continue his connection with the school who shows persistent unwillingness or inability to comply with these requirements.

Prompt attendance is required of all students at the regular class exercises and satisfactory excuses must be rendered to the instructor in charge for all absences from his class. If the total number of absences, excused or unexcused, in any class exercise amounts to one-fifth of the total number required for the semester, the student may be debarred from further attendance in that class or department of study.

SCHOLARSHIP GRADES

Each student shall receive a final mark at the end of each semester. The passing grade shall be seventy per cent. If a student's grade in any subject shall fall below fifty-five per cent., the grade registered shall be "failed," and the work must be repeated in class. Also, further attendance in that line of study, if it is a study continued to another semester, must be discontinued until the passing grade is obtained on the work which was a failure. In case a student's grade in any subject falls between fifty-five and seventy per cent., he is conditioned in that subject, but may continue and receive credit for the work, provided the condition is removed within a reasonable time after the condition has been incurred.

A student may withdraw from a course in which he has registered during the first two weeks with the consent of the instructor, registrar, and president. After this time he may withdraw only with the consent of the faculty. All withdrawals must be formal and must be recorded by the student with the registrar.

EMPLOYMENT AND AID FOR STUDENTS

A large number of students of the School of Mines earn either the whole or a part of their expenses while in college. The School cannot guarantee work for students, but under ordinary conditions of mining most of the students find work in the mines for two shifts a week. A few students find work about the school as stenographers and laboratory assistants. During the summer vacations students readily find profitable employment in many occupations, but especially in mining.

MILITARY SERVICE SCHOLARSHIPS

Upon the proper certification of the president that a student has rendered military or naval service to the nation and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service Scholarship to such student. The holders of such scholarships, throughout the course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

By special action of the State Board of Education the privileges of the Military Service Scholarship are extended to all students of the University of Montana who met the requirements for membership in the Students' Army Training Corps, and to all who actually took up work in one of the corps of the University of Montana, but were deprived of induction through the action of the War Department cancelling all inductions which were not complete November 11, 1918.

GENERAL UNIVERSITY STUDENT LOAN FUNDS

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds, which are available for students in the junior and senior classes of any of the institutions of the University of Montana who are unable to continue their studies without financial aid and are satisfactorily recommended as to character and scholarship by the dean or director or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loans must be repaid within one year from the time of borrowing, or, in exceptional cases, one year after graduation. Loans bear two per cent. interest.

AUXILIARY WORK

BUREAU OF MINES AND METALLURGY

The Legislative Assembly of Montana for 1919 (Chapter 161, Page 311), established in the State School of Mines a State Bureau of Mines and Metallurgy. A fund of $20,000.00, necessary for the maintenance of the Bureau, was appropriated for the biennium ending Feb. 28, 1921.

The bureau is organized into four major departments, Administration, Geology, Mining, and Metallurgy and Safety.

The object and duties of the bureau, as specified by law, are as follows:

1. To collect, to compile, and to publish statistics, relative to Montana geology, mining, milling, and metallurgy.

2. To collect typical geological and mineral specimens and samples of products; to collect photographs, models, and drawings of appliances used in mines, mills, and smelters of Montana.

3. To collect a library and a bibliography of literature pertaining to or useful for the progress of geology, mining, milling, and smelting in Montana.

4. To study the geological formations of the State with special reference to their economic mineral resources, both metallic and nonmetallic.

5. To examine the topography and physical features of the State with reference to their practical bearing upon the occupations of the people.

6. To study the mining, milling, and smelting operations carried on in the State, with special reference to their improvement.

7. To prepare and to publish bulletins and reports, with necessary illustrations and maps, which shall embrace both a general and a detailed description of the natural resources and geology, mines, mills, and reduction plants of the State.

8. To make qualitative examinations of rocks and mineral samples.

9. To consider such other scientific and economic problems as in the judgment of the State Board of Education are of value to the people of the State.

10. To communicate special information on Montana geology, mining and metallurgy.

11. To co-operate with the other departments of the University of Montana, with the State Mine Inspector, and with other departments of the State Government as may be mutually beneficial; and to co-operate with the United States Geological Survey, and with the United States Bureau of Mines, in accordance with the regulations of those institutions.

The results of the work of the bureau are published in bulletins and circulars, which are distributed free of cost to those requesting them. The bureau has been established primarily for service, and so far as is reasonable all problems and questions relating to the mineral resources or mining and metallurgical industry of the State will receive careful consideration. All samples and letters should be addressed to the State Bureau of Mines and Metallurgy, Butte, Montana.

STUDENT ACTIVITIES

While it is impossible in an engineering school to maintain as wide a range of student activities outside of classroom instruction as is possible in colleges which specialize in other lines of work, yet it is recognized that these activities are, and should be, a part of the life of a normal student. As much encouragement is given them as is consistent with good work in the courses of study.

THE A. S. S. M.

The Associated Students of the School of Mines is a regularly organized association of which any student may be a member if he has paid the student activity fee. It has general supervision over all matters in which the students as a whole are interested. It also has the power to determine to what extent student government may apply in controlling traditions, general conduct, and the action to be taken when student rules are broken. General control of athletics, student publications, debating, and other activities which affect all the student body is in its hands.

ATHLETICS

As much encouragement is given to intercollegiate and interclass athletics as is possible in a school of this type. Teams were maintained last year in football and basketball, and schedules were played with Montana and other Northwestern colleges appearing on the list. The eligibility rules of the Northwest Intercollegiate Conference are in force. Competent coaching is secured for the various athletic teams. Within a short time it is hoped that the facilities of the school for athletics will be increased and that it may be possible to add track and baseball to the sports now maintained. In Butte there are several good gymnasiums which have swimming pools and handball courts. No student need lack for physical exercise and games in good surroundings if he desires them.

THE MINING SOCIETY

The Mining Society is an organization to promote the discussion of mining and engineering topics and to develop good fellowship among the men in attendance. Smokers are held every few weeks, at which speak men of prominence in mining and engineering work who have subjects of practical interest to discuss. The Society is affiliated with the American Institute of Mining and Metallurgical Engineers as a Junior Branch.

THE DANCING CLUB

The Dancing Club has general supervision over all social affairs given by the student body, as a whole, or by the various classes, as a whole. Under its guidance are held the Junior Prom, the Christmas Dance, and other social events of the school year.

JUNIOR AND SENIOR TRIPS

It has long been the custom for the Juniors and Seniors to take an inspection trip to Montana and other mining districts before work ends in the Spring. These trips are planned with the advice and approval of the faculty, and they are conducted under the direction of members of the faculty. It is required that the inspection work on these trips and the reports asked afterwards be satisfactory to the faculty members in charge before credit is given towards graduation.

Organization of Instruction

The State School of Mines offers courses leading to the degrees of Mining Engineer, and of Metallurgical Engineer, the latter to be conferred for the first time in 1922.

As now organized, the School consists of four major departments, mathematics and mechanics, metallurgy and chemistry, geology and mineralogy, and mining engineering. Mathematics and mechanics are required as fundamental for all forms of engineering, and the other three departments emphasize the three main branches of mining. In addition to the subjects offered in these major departments, classes are given in English composition, economics and law, physics, and Spanish.

COURSES IN MINING ENGINEERING

For the Class of 1924 and Thereafter

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	2	1½
Algebra	3	3
Trigonometry	3	3
Geology	3	2
General Chemistry:		
Lectures and Recitations	4	4½
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	17

Second Semester

	Hrs. of Exer.	Units
English Composition	2	1½
Analytical Geometry	3	3
Plane Surveying	3	3
Geology	3	2
Qualitative Analysis:		
Lectures and Recitations	4	5½
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mech.	4	4
Physics	3	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mining	2	2
Mine Surveying, Theory	2	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Structural Geology	2	1
Metallurgy	2	1½
Fire Assaying	1	½
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2-wk.	2
Mapping	3	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
Physics Laboratory	6	2
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology of North America:		
Lectures	2	2
Laboratory	3	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
Graphics	3	1
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	4
Field Geology	3-wk.	1½
	28	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
	28	16

COURSES IN MINING ENGINEERING

For the Classes of 1922 and 1923

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	5
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
Qualitative Analysis:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics:		
Lectures and Recitations	4	4
Laboratory	3	
Geology	3	2
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy	2	1½
Fire Assaying	1	½
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2 wk.	2
Drawing	3	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Assaying	6	2
Mining:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	4
Field Geology	3-wk.	1½
	28	17½

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	3	2
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
	28	16

COURSES IN METALLURGICAL ENGINEERING

For the Class of 1924 and Thereafter

FRESHMAN YEAR

First Semester	Hrs. of Exer.	Units
English Composition	2	1½
Algebra	3	3
Trigonometry	3	3
Geology	3	2
General Chemistry:		
Lectures and Recitation	4	4½
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	17

Second Semester	Hrs. of Exer.	Units
English Composition	2	1½
Analytical Geometry	3	3
Plane Surveying	3	3
Geology	3	2
Qualitative Analysis:		
Lectures and Recitation	4	5½
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics	3	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	4
Laboratory	9	
Mining	2	2
	30	17

JUNIOR YEAR

First Semester	Hrs. of Exer.	Units
Engineering Economics	2	2
Structural Geology	2	1
Metallurgy:		
Lectures	2	2½
Drawing	3	
Fire Assaying	1	½
Electro Chemistry:		
Lectures	2	3
Laboratory	6	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
Physics Laboratory	6	2
	30	16

Second Semester	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology of North America:		
Lectures	2	2
Laboratory	3	
Metallurgy	3	2
Assaying	6	2
Physical Chemistry:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
Graphics	3	1
	30	16

SENIOR YEAR

First Semester	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Electro Metallurgy	3	3
Metallurgy Problems	3	3
	26	16

Second Semester	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Metallurgy:		
Lectures	3	4
Laboratory	3	
Metallurgy Problems	3	3
	26	16

COURSES IN METALLURGICAL ENGINEERING

For the Classes of 1922 and 1923

FRESHMEN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	3	3
Trigonometry	5	3
General Chemistry:		
Lectures and Recitation	4	5
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	16

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	3
Plane Surveying	3	3
Qualitative Analysis:		
Lectures and Recitation	4	6
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	16

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	4	3
Geology:		
Lectures	3	3
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics:		
Lectures and Recitations	4	4
Laboratory	3	
Geology	3	2
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mine Surveying—Theory	2	1
Graphics	3	1
	29	17

JUNIOR YEAR

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy:		
Lectures	2	3
Laboratory	6	
Metallurgy:		
Lectures	2	2½
Drawing	3	
Fire Assaying	1	½
Electro Chemistry:		
Lectures	2	3
Laboratory	6	
Thermodynamics and Mechanical Engineering	3	2
Mechanics	3	3
	30	16

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Metallurgy	3	2
Assaying	6	2
Physical Chemistry:		
Lectures	2	2
Laboratory	3	
Hydraulics	3	3
Dynamo Electrical Machinery	3	2
	30	16

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Electro Metallurgy	3	3
Metallurgy Problems	3	3
	26	16

Second Semester

	Hrs. of Exer.	Units
Metallurgy:		
Lectures	3	5
Laboratory	6	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Metallurgy:		
Lectures	3	4
Laboratory	3	
Metallurgy Problems	3	3
	26	16

CHEMISTRY

PROFESSOR, L. J. HARTZELL. ASSOCIATE PROFESSOR, A. E. KOENIG

General Chemistry: 1 S. Fall. 4½ credits. Deposit, $15.00.* Freshmen. Lectures, recitations, and laboratory. The object of the course is to develop the underlying principles of the subject as a basis for all subsequent work in the department. The student is drilled on the laws governing chemical phenomena,. and is made familiar with the principal characteristics and relations of the elements. The work is illustrated by experiments, conducted either by the instructor or the student. Text: "General Chemistry for Colleges," by Louis Kahlenberg. Mr. Koenig.

Qualitative Analysis: 1 S. Spring. 5½ credits. Deposit, $15.00* Freshmen. Prerequisite, General Chemistry. Lectures, recitations and laboratory. The course is designed to instruct the student in the general scheme for the separation and detection of the metallic elements and the more common acid radicals. Chemical arithmetic or stochiometry is given during the latter part of the course. Text: "Qualitative Analysis," by Prescott and Johnson. Mr. Hartzell.

Quantitative Analysis: 2 S. Continuous. 6 credits. Deposit, $15.00. Sophomores. Prerequisite, Qualitative Analysis. Lectures, recitations, and laboratory. The course is designed to meet the needs of the mining engineer, and the object is to develop the student's ability to perform quantitative analysis rapidly and accurately. The problems in the laboratory are selected as far as possible from the work of the practitioner in the smelters and mines of the West. The course emphasizes all the general methods of analysis as applied to limestones; dolomites; ores of iron, mercury, lead, zinc, copper, arsenic, antimony, and tin; rocks; cements; slags; mattes; and water.

The principles of acidimetry and alkalimetry are studied and explained and demonstrated by the analysis of acid and alkaline solutions.

While the practical features of quantitative analysis are emphasized, these are primarily employed to develop the theory and to show the practical application of chemical theory. Text: A. H. Low, "Technical Ore Analysis." Lecture notes. Mr. Hartzell.

Electro-Chemistry: 1 S. Fall. 3 credits. Deposit, $10.00. Juniors. Prerequisites; General Chemistry, Physics, Qualitative and Quantitative Analysis. Two lectures and six laboratory hours a week. This course is a study of the theories of electrolysis, conductance, of electrolytes, electro-motive force, and polarization. The laboratory work takes up the measurements of conductivity, electro-motive force, and resistance simple potentials; electro-disposition of metals; and electro-analysis. Texts: Findlay, "Practical Physical Chemistry", and Watts, "Laboratory Course in Electro-Chemistry." Mr. Koenig.

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*NOTE: The $15.00 fee required for General Chemistry includes the deposit for Quantitative Analysis when the latter is taken in direct continuation of the former.

Physical Chemistry: 1 S. Spring. 2 credits. Deposit, $10.00. Juniors. Prerequisites, General Chemistry, Physics, Qualitative and Quantitative Analysis. Two lectures and nine laboratory hours a week. While some attention is paid to the application of physical methods of chemistry, and to the qualitative and quantitative theories of chemical equilibria, as given by the phase rule and the mass law, the special stress in this course is laid on the study of the effects of the equilibrium factors on chemical reaction. Text: Lewis, "A System of Physical Chemistry." Laboratory manual: Findlay, "Practical Physical Chemistry." Mr. Koenig.

Note: Physical Chemistry and Electro-Chemistry are not required in the Mining Engineering Course.

ENGLISH AND ECONOMICS

PROFESSOR, W. T. SCOTT.

English Composition: 2 S. Continuous. 3 credits. Freshmen. Lectures and recitations. The purpose of the course is to arouse the student to a realization of the importance of being able to use good English, and to teach him how to write and speak clearly, accurately, and easily, especially upon scientific and engineering topics. The course also aims to prepare for the ordinary use of English in business and to explain the principles which lie back of business usage. The first semester includes work in the fundamentals of composition, speaking, and parliamentary law. The second semester specializes on business English, but continues the work in speaking, emphasizing its use in business. Texts: "The Century Handbook of Writing," by Garland Greever and Easley S. Jones; "Handbook of Parliamentary Law," by F. M. Gregg; "Practical Business English," by O. C. Gallagher and Leonard B. Moulton. Mr. Scott.

Engineering English: 2 S. Continuous. 4 credits. Sophomores. Oral and written exercises in describing and explaining mechanical devices, engineering processes, and scientific principles; followed by formal written reports such as are required of engineers; and completed by oral reports which must stand up under group criticism and questioning. Texts: "Technical Writing," by T. A. Rickard; "The Composition of Technical Papers," by Homer Andrew Watt. Mr. Scott.

Engineering Economics: 2 S. Continuous. 4 credits. Juniors. Lectures and recitations, elementary economics, sociology, business management, and law as applied to the mining industry in particular and to the engineering industry in general. Attention is also given to modern industrial problems which affect the mining industry particularly. Text: "The Introduction to the Study of Economics," by Charles J. Bullock. Mr. Scott.

GEOLOGY AND MINERALOGY

PROFESSOR, C. H. CLAPP. ASSISTANT PROFESSOR, G. S. LAMBERT.

Mineralogy: 2 S. Continuous. 3 credits. Deposit, $5.00. Juniors. Prerequisite, Qualitative Analysis. Lectures, recitations, laboratory, museum study, and field excursions. The purpose of the course in mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests, and by sight, is the object sought. The course is divided into crystallography, blow pipe analysis, and determinative and descriptive mineralogy. Text: "Dana's Manual of Mineralogy," by W. E. Ford. Mr. Lambert.

Geology: 2 S. Continuous. 4 credits. Freshmen. Lectures and field excursions. Physiographic, dynamic, and structural geology are first studied, followed by a brief outline of historical geology and geology of North America. Montana geology is given particular attention. The needs of the mining engineer are kept constantly in mind, and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text: "Textbook of Geology," by Pirsson and Schuchert. Mr. Clapp and Mr. Lambert.

Economic Geology: 1 S. Fall. 4 credits. Seniors. Prerequisite. Geology and Mineralogy. Lectures and recitations. A course in the more theoretical aspects of the geology of ore deposits, including structural features, transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and non-metallic, especially those of North America, is gained by the preparation of reports and maps. Text: "Mineral Deposits," by W. Lindgren. Mr. Clapp.

Field Geology: Three weeks field work. 1½ credits. Seniors, Prerequisite, Geology, Mineralogy, and Plane Surveying. A course in the various methods of geological surveys, including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared, but material for laboratory study is collected and geological reports are written. Mr. Clapp.

Mining Geology: 1 S. Spring. 5 credits. Seniors. Prerequisite, Economic and Field Geology. Lectures, recitations, and field work. Application of geology of ore deposits to practical mining problems, and two weeks of field work in the principles and practice of underground geologic mapping, with the preparation of geological reports on the mines examined. Mr. Clapp.

MATHEMATICS AND MECHANICS

PROFESSOR, GEORGE W. CRAVEN. ASSOCIATE PROFESSOR, A. E. ADAMI.
ASSISTANT PROFESSOR, E. RALPH BOWERSOX.

Algebra: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. After a preliminary course, designed to drill the student in the fundamental algebraic operations, and in the statement and solution of problems, those operations of advanced algebra, which will be of use to the student in future engineering courses, are carefully studied. Special attention is given to the use and theory of exponents and logarithms, simultaneous quadratic equations, variation, the more common series with their practical applications, and undetermined coefficients. Text: "College Algebra," by Wentworth. Mr. Bowersox.

Trigonometry: 1 S. Fall. 3 credits. Freshmen. Lectures and recitations. In plane trigonometry the subjects of primary importance are goniometry, solutions of right and oblique triangles, and practical problems. Those considered in spherical trigonometry are the solution of right and oblique spherical triangles, and their development and practical application to surveying and measurement. Text: "Plane and Spherical Trigonometry," by Wentworth. Mr. Adami.

Analytical Geometry: 1 S. Spring. 3 credits. Freshmen. Prerequisites, Algebra, Tigonometry. Lectures and recitations. The material gathered from algebra, geometry, and trigonometry is combined in a manner which leads to a practical knowledge of these branches of mathematics. The student is required to study and plot accurately numerous problems covering such topics as the point and straight line in the plane, different systems of co-ordinates, conic sections, higher plane curves, the point and straight line in space, curved surfaces, and surfaces of revolution. Toward the end of the course the student is required to study various mechanical movements, to devise movements, and to determine the laws and equations involved. Text: "New Analytical Geometry," by Smith and Gale. Mr. Bowersox.

Calculus: 1 S. Fall. 4 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures and recitations. Differential and integral calculus covering the following subjects: Differentiations, tangents, normals, subtangents, subnormals, asymptotes, indeterminate forms.

logarithms, maxima and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text: "Differential and Integral Calculus," by Taylor. Mr. Craven.

Calculus and Analytical Mechanics: 1 S. Spring. 4 credits. Sophomores. Prerequisite, Calculus. Lectures and recitations. A continuation of the course in Calculus, and a consideration of the theoretical principles of mechanics. Text: "Differential and integral Calculus," by Taylor. Mr. Craven.

Mechanics: 1 S. Fall. 4 credits. Juniors. Prerequisite, Calculus and Analytical Mechanics. Lectures and recitations. In the course are considered the strength of materials, the laws of elasticity and resiliency, impact, fatigue, and the theory of beams and columns or struts. The course also includes a study of the properties of various building materials—the metals, timber, stone, brick, and cement.

It is the object of this course to direct the attention of the student to the elements of machinery design. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keys, pipes and pipe fittings, shafting, couplings, cylinders, and structural steel design. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, and ropes. Special attention is given to the installation and maintenance of machinery, and in this connection a great deal of practical information is gained by frequent visits to the repair shops of the Butte mines. Text: "Mechanics of Materials," by Merriman. Mr. Craven.

Mechanics and Hydraulics: 1 S. Spring. 4 credits. Juniors. Prerequisite, Mechanics. Lectures and recitations. Following the conclusion of the course in mechanics, the course in hydraulics is introduced with a study of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involving the flow of water through orifices, over weirs, through piles, flues, and conduits. Attention is given to the design of dams and their adjuncts and to the investigation of the various water wheels, and governing devices. Text: "Treatise on Hydraulics," by Merriman. Mr. Craven.

Physics: 2 S. Continuous. 6 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures, recitations, and laboratory. The topics considered are: Concurrent and parallel forces; center of gravity; inertia and rotation; friction and work; simple machines; mechanics of fluids; nature and measurement of heat and its application to the steam engine, and to the transmission of energy by means of compressed air; electricity and magnetism; a brief study of light and sound, including a study of optical instruments and of the phenomena met in the study of mineralogy and petrography; and the application of electricity to dynamos, motors, transmission of energy, and lighting. Text: "College Physics," by Kimball. Mr. Bowersox.

Thermodynamics and Mechanical Engineering: 1 S. Fall. 2 credits. Juniors. Prerequisites, Physics and Calculus. Lectures, recitations, and excursions. Following a short course in thermodynamics, a systematic study is made of the mechanism of engines, simple, condensing, and continuous expansion, foundations, bed plates, steamboilers and their adjuncts, and their setting and management, design and construction of chimneys, and general plans for power houses. Text: "Steam Engines and Boilers," by J. H. Kinearly.

In addition, a series of descriptive lectures of pumps and pump details, and the construction and management of mining pumps, is given. Text: "Pumping Machinery," by W. M. Barr. Mr. Craven.

Dynamo Electrical Machinery: 1 S. Spring. 2 credits. Juniors. Prerequisite, Physics and Mechanics. Lectures, recitations and excursions. The student's attention is directed to the general conditions of power transmission, synchronous and induction motors, current reorganizers, hydraulic development, organization of a power station, line construction, centers of distribution, commercial problems, and measurement of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this field. Text: "Power Transmission," by Bell. Mr. Craven.

Mechanical Drawing and Descriptive Geometry: 2 S. Continuous. 5 credits. Freshmen. Lectures and drawing room. The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. Students are required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to them. It is the aim to guard against the copying of drawings, so that the student learns to think and construct for himself. The course includes practice in freehand lettering, and the student is taught the use of water-color as applied to engineering drawing. Practice is also given in coloring maps and shading parts of machine drawings. As far as possible the problems in drawings are taken from those met by the engineer in practice. The study of descriptive geometry is completed and applied to engineering design. Texts: "Mechanical Drawing" and "Descriptive Geometry," by L. Faunce. Mr. Craven and Mr. Adami.

Graphics: 1 S. Spring. Juniors. 1 credit. Prerequisites, Mechanical Drawing and Descriptive Geometry. Lectures, recitations, and drawing. The course in graphics is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge, or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind, and snow. Text: "Steel Mill Buildings," by Ketchum. Mr. Craven.

METALLURGY

PROFSSOR, H. T. MANN. ASSISTANT, M. F. HALEY.

Principles of Metallurgy: 1 S. Fall. 1½ credits. Prerequisite, Quantitative Analysis and Physics. Lectures, recitations, plant inspections, and reports. The course is an introduction to the study of metallurgy. The nature of the metals is considered, with outlines of the principles and practices for the winning of all the common metals. The metallurgical industries have their nature and importance presented, after which those operations and processes common to several metals are studied. Students are taken to local plants, have the work explained, and are then required to prepare suitable reports. Mr. Mann.

Metallurgy Laboratory: 1 S. 1 credit. Juniors in Metallurgical Engineering. Prerequisite, to be accompanied by Principles of Metallurgy. This course is intended for men who wish a degree in metallurgical engineering. It will take up in detail Pyrometry, Refractories, Fuel Testing, Gas Analysis, the Physical Properties of Metals, Cooling Curves, Roasting, Study of Slags, Use of the Microscope in Metallurgy, and Ore Dressing and Heat Conduction. Mr. Mann.

Metallurgy of Copper: 1 S. 2 credits. Juniors. Prerequisite, Principles of Metallurgy. The metallurgy of copper is considered along the following lines: The properties and uses of copper, its compounds, and its alloys; the markets for copper and its ores and the principles underlying their sale and price; the ores of copper; the smelting of roasted and oxidized ores of copper to black copper, touched on briefly; the roasting of copper ores as a preliminary to blast-furnace and reverberatory smelting; the handling of the smoke from copper furnaces to save the values contained therein and to remove from these gases their injurious constituents; the smelting of roasted ores to matte in the reverberatory furnace; the smelting of roasted ore to matte in the blast furnace, either with or without the attempt to volatilize a considerable portion of the sulphur; the smelting of raw massive sulphides to matte in the blast furnace, or pyrite smelting; the converting of copper matte to blister copper in the basic and in the acid converter; the furnace refining of copper; the production of copper from matte by the various roast-reaction of roast smelting methods; the electrolytic refining of copper; and hydrometallurgy of copper. Mr. Mann.

General Metallurgy: 1 S. Fall. 6 credits. Deposit, $15.00 Seniors. Prerequisite, Principles of Metallurgy and Fire Assaying. This course includes a study of the metallurgy of lead, and gold and silver.

Metallurgy of Lead: The course in the metallurgy of lead includes work along the following general lines: The properties and uses of lead, its alloys, and compounds; the ores of lead and the methods and principles of their sale; the principles and practice of sampling the ores and their products; the general principles used in the winning of lead from its ores; the treatment of lead ores in the reverberatory smelting furnace; the winning of lead from its ores by smelting in the ore hearth, or Scotch hearth, considerable attention being paid to this method on account of its importance with the ores of the Mississippi Valley; the roasting of lead ores and the strides that have recently been made in this important preliminary to the lead blast furnace; the winning of ores in the lead blast furnace; (this heading is, of course, an important one in the subject, and under it are taken up the blast-furnace plant, the chemistry of the blast furnace, the calculation of furnace charges, the calculation of the costs of smelting, and the handling of products, particularly the smoke or fume); the desilveration of base bullion by means of the Parkes, Pattison, and cupellation processes, as well as by the Betts process. Throughout this course, as well as the other courses of this department, the work is accompanied by problems which bring out the ideas which the classroom work considers.

Metallurgy of Gold and Silver: The study of the metallurgy of gold includes lectures and recitations along the following general lines: The properties of gold, gold alloys, and the compounds of gold; the winning of gold from placer ground by dredging and hydraulicking, including methods of investigating the value of placers; the chlorination and bromination of gold ores, considered more in the light of the historic value of these processes than for their present inportance as schemes of gold extraction; the amalgamation methods of silver and gold ores are taken up in detail in the course on ore dressing. The study of the metallurgy of silver is considered as suggested by the following topics: The properties of silver, of its alloys, and of its compounds; the winning of silver from its ores by the various leaching schemes that were formerly of greater importance than at present, schemes which include the Augustin process, the Ziervogel or Argo process, and the various methods of hyposulphite leaching, each considered only briefly. The greater part of the time of the course in gold and silver is devoted to the study of the cyanide process, which is considered in detail. The parting of gold and silver by the various acid and electrolytic schemes and the winning of gold and silver from their ores by the various smelting schemes are considered under the head of metallurgy of lead and copper. Mr. Mann and Mr. Haley.

General Metallurgy: 1 S. Spring. 5 credits. Deposit, $15.00. Seniors. Prerequisites, Metallurgy of Copper and Lead, and Fire Assaying. This course includes a study of the metallurgy of zinc, iron and steel, tin, antimony, and aluminum.

The metallurgy of zinc is considered under the following headings:

The properties and uses of zinc, its alloys, and compounds; the ores of zinc and the methods and the principles underlying their sale; the roasting of zinc ores, with a brief study of the use of zinc ores as a source of sulphuric acid; the distillation of zinc ores and the furnaces suited for this purpose; the factors on which the success of the distillation depends; the manufacture of retorts and condensers; the laws of condensation of vapors to liquids and their application to the condensation of zinc vapors; the products of zinc smelting, and the methods of handling and treating these products; the cost of smelting zinc ores figured on the basis of a number of typical ores; the refining of spelter; the markets for spelter and the various brands of spelter; special schemes other than the ordinary methods that have been used or proposed for use in the winning of zinc from its ores; the manufacture of zinc oxide pigment. Throughout this course problems are given to illustrate the ideas set forth in the class.

The metallurgy of iron and steel takes up the following topics; The use of ferrous materials; the production and properties of pig-iron, cast-iron, wrought-iron, and the various kinds of steel; the making of ingots; the mecahnical and heat-treatment of steel; and the correlation of structure and properties to intended use. The class also studies and reports upon several local foundries. Mr. Mann and Mr. Haley.

Fire Assaying: 1 S. ½ credit. Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Lectures and recitations. This course deals with the theory of fire assaying as practiced in the laboratory. Mr. Mann.

Fire Assaying: 1 S. Spring. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Laboratory course. The study of assaying is approached from both the theoretical and practical sides. The course is intended to increase the proficiency of the student in thinking, in knowledge, and in manipulative skill. A great variety of ores, furnace products, and metals are worked upon in the laboratory by the best methods. Text: "The Sampling and Assay of the Precious Metals," by Smith. Mr. Mann and Mr. Haley.

Electro-Metallurgy: 1 S. Fall. 3 credits. Seniors in metallurgical engineering. Prerequisite, Electro-Chemistry and Principles of Metallurgy. Lectures and recitations. Lectures are given covering the electro-metallurgical processes that are in use. Efficiency and engineering calculations based on these processes are also given. Mr. Mann.

Metallurgy Problems: 2 S. Continuous. 6 credits. Seniors in metallurgical engineering. Prerequisite, Principles of Metallurgy, the Metallurgy of Copper. Lectures and recitations. This course aims to cover the common problems that the metallurgist meets in practice. Mr. Mann.

Physical Metallurgy: 1 S. Spring. 4 credits. Seniors in metallurgical engineering. Prerequisite, Metallurgy of Lead. Lectures, recitations, and laboratory. This course deals with the theoretical and practical considerations that influence the structure and properties of alloys of different types. Mr. Mann.

MINING ENGINEERING AND SURVEYING

PROFESSOR, THEODORE SIMONS. ASSOCIATE PROFESSOR, A. E. ADAMI.

Plane Surveying: 1 S. Spring. 3 credits. Freshmen. Prerequisite, Algebra and Trigonometry. Lectures and recitations. The course in the theory of plane surveying takes up the construction, adjustment, use, and care of surveying instruments, the form of field notes for different methods of surverying, computation of bearings, co-ordinates, elevations, areas, and quantities of material, from data secured in the field, the solution of problems in surveying, and practical uses of surveying instruments on the school grounds. Text: "Plane Surveying," by Tracy. Mr. Adami.

Plane Surveying, Field Work: Summer Field Work, 4 weeks. 2 credits. Deposit, $10.00. Sophomores. Prerequisite, Plane Surveying. During the course in plane surveying the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, calculation sheets; determination of true meridian by solar observation and by observation on Polaris; traverse survey with transit and steel tape; angles by repetition; azimuth and deflection; problems in public land surveying in accordance with Manual Instruction to United States Deputy Surveyors; official survey of mining claims and application for United States patent; returns to consist of letters of transmittal, plat, field notes, and computations, in form of transmission to United States Surveyor General; topographic survey with transit and steel tape; stadia and trigonometric survey; base line triangulation; leveling for profile and contour lines, and for establishment of bench marks; staking out buildings and excavations for foundations, and calculations of quantities to be excavated; survey of ditch or flume line; preliminary and location survey of railroad. Mr. Adami.

Topographic Drawing: 1 S. Fall. 2 credits. Sophomores. Prerequisites, Plane Surveying, Field Work. The work consists of platting on a suitable scale the surveys executed in the field. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps and mills. Additional instruction is given in the construction of contour lines and in the laying out of railroads and wagon roads, dams, reservoirs, flumes, and ditches on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, by cross sections made from contour maps. During the work special attention is given to lettering, titles, borders, and north points, and general neatness in execution. Mr. Adami.

Mine Surveying: 1 S. Spring. 1 credit. Sophomores. Prerequisites, Plane Surveying, Topographical Drawing, and Descriptive and Analytical Geometry. A course of lectures on underground surveying and shaft plumbing, including the mathematical and graphical solution of numerous surveying problems. Mr. Simons.

Mine Surveying, Field Work, and Mapping: Summer Field Work, 2 weeks. 1 S. Fall. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Mine Surveying. During the course in Mine Surveying, carried on at a mine in actual operation, the students are required to execute the following surveys and prepare the necessary field notes: Plumbing the shaft; a complete survey of the underground workings, as well as all important surface features, such as buildings, ore bins, tracks, claim boundaries, and streets. In the class-room all necessary calculations are made for the final platting of the field notes, and a composite map is made showing the underground workings, surface plant, claim lines, and city streets. In addition, a number of sections are made showing the occurrence of the ore bodies, position of shafts, levels, cross-cuts, stopes, and the vertical relation of the ore bodies to the underground workings. Mr. Simons.

Mining: 2 S. Continuous. 5 credits. Juniors. Prerequisite, Mine Surveying. Lectures, drawing, and laboratory. The course in mining takes up the following topics: prospecting, discovery, locating and acquiring title to mining claims, breaking ground by various methods of hand work, rotary and precussion drills, explosives and their uses, supporting excavations by timbering, masonry, and metallic supports. The lectures and recitations are illustrated by drawings, prints, models, and frequent visits to the local mines. While at the mines special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drills, and boring by percussion drills. In the laboratory actual tests on various kinds of drills are given, with a view to determine the air consumption, rate of drilling, efficiency, and cost of operation. In the drawing room the students are taught to make drawings of structures in wood, masonry, and metal, including ore and coal bins, railroad trestles, headframes, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems, with all conditions and requirements, are dictated to the students, and numerous blue prints of actual constructions are on file for reference. Mr. Adami.

Mining: 2 S. Continuous. 4 credits. Seniors. Prerequisites, Junior Mining, Physics, Hydraulics, and Mine Surveying. Lectures and design. A course in air compression, prospecting for placer deposits, exploitation of gold placers by various methods, including hydraulicking and dredging, water supply for hydraulic and other mining operations, reservoirs, dams, ditches, and pipe lines, exploitation of useful minerals by open work and various methods of underground stoping, mine haulage, hoisting, and hoisting machinery and accessories, drainage and pumping, ventilation, natural and artificial, light and sanitary arrangements, commercial mining operations, superintendency and management of mines, selecting and buying samples and machinery, mine economics and mine accounts, examination and reporting on mines and mining enterprises. Mr. Simons.

Ore Dressing: 2 S. Continuous. 8 credits. Seniors. Prerequisite, Mechanics, Junior Mining, Physics, and Calculus. Lectures, design, and laboratory. A study of the physical laws governing the various processes of ore dressing, such as crushing, jigging, free and hindered settling, the principles of screen sizing and hydraulic classification, the construction and operation of typical milling machinery, rolls, grinding mills, jigs, tables, vanners, magnetic separators, flotation processes, and mill accessories, power transmission and water supply for milling operations. The study of design and methods of ore dressing is further carried on at plants visited during the school year and by practical tests in the ore-dressing department of the school laboratory. From the design of single structures, the course leads to the design of a complete plant for one or more operations of mining and ore dressing. It is the aim of this course to develop the originality of the student; although the instructor in charge is always on hand to assist, the student is on his own resources as far as possible. He is required to make use of catalogs and reference books to obtain the data necessary for the completion of his problem. Attention is given to the assembling, bills of materials, and the item of costs. The problems are given to the student and discussed in the class-room.

The course in mining and ore-dressing is completed by a two weeks' excursion into districts where mining and ore-dressing methods which do not prevail in the Butte district can be studied. Mr. Simons.

SPANISH

INSTRUCTOR, B. F. THOMAS.

Elementary Spanish: 2 S. Continuous. 6 credits. Elective. Open to all students. Texts: "Spanish Grammar," by Espinosah and Allen, and "Lecturas Facilies," by Wilkons. Mr. Thomas.

Register of Students

1920-1921

SENIOR CLASS

*Amberson, Julius	Mandan, N. D.
*Fredell, C. A.	Anaconda
*McGonigle, Walter L.	Butte
*O'Donnell, Neil Arthur	Butte
*Rowe, Francis A.	Butte
*Symons, Henry H.	Butte
*Taylor, Maurice H.	Anaconda
*Werelius, Walter R.	Ramsey
*Whealdon, Alfred N.	Portland, Ore.

JUNIOR CLASS

*Adelstein, Benjamin	Butte
*Baker, Thomas D.	Butte
Bigelow, Frank O.	Butte
*Bishop, Lester F.	Butte
*Bowlby, Robert H.	Butte
*Brockway, A. Grove	Spokane, Wash.
*Carroll, Walker B.	Butte
*Dougherty, James	Anaconda
*Driscoll, Timothy H.	Butte
*Eaves, Lucian, Jr.	Butte
*Freshman, Walter C.	Butte
*Frink, Ellis P.	Portland, Ore.
Groom, Carl M.	Butte
Judge, Joseph A.	Butte
*Kirwan, Gerald M.	Contact
*Landwehr, Walter R.	Cottage Grove, Ore.
*Lee, Harold R.	Superior, Wis.
McDonald, Alex M.	Butte
*MacLellan, Donald D.	Butte
*Merrill, William L.	Butte
Mowbray, Willard W.	Anaconda
*Naughten, James J.	Butte
*Nuckols, John A.	Anaconda
O'Brien, Wallace	Butte
*Peterson, John N.	Terraville, S. D.
*Scarlett, William A.	Lynn, Mass.
Shea, Edward P.	Butte
*Stanaway, Ray C.	Butte
*Thomas, Roy E.	Anaconda
*Wade, Ralph J.	Butte
*Walde, Leonard O.	Superior, Wis.

SOPHOMORE CLASS

*Borel, Arnold E.	Eldred, Pa.
Downey, Melvin H.	Butte
*Elder, Robert A.	Miles City
Gay, Ingles M.	Butte
Harmon, Charles H.	Grass Range
*Harrington, L. T.	Butte
Healy, Aloysius	Butte
*James, John W., Jr	Anaconda
*Kennedy, Willard C.	Butte
*Kirchner, Oswald J.	Rochester, N. Y.
*Ladic, Sanford W.	Butte
*Lee, Wallis H.	Glendive
*McGovern, Eugene L.	Butte
*McGreal, Charles C.	Butte
*McMaster, P. Donald	Butte
McNeil, Charles L.	Anaconda
McQuay, Ray	Butte
*MacDonald, George D.	Butte
*Maloney, William G.	Butte
Martin, James E.	Butte
*Moran, Aloysius J.	Butte
Murphy, William	Butte
*Nutting, Haven C.	Thompson Falls
Osterholm, Victor L.	Butte
*Price, William	Red Lodge
*Quinn, Hugh M.	Butte
*Rudolph, Joseph	Butte
Sahinen, George F.	Butte
*Schwanz, Fred D.	Butte
*Smith, Irwin N.	Butte
*Smith, Robert J.	Great Falls
*Steadman, Aaron	Butte
*Streibich, Frederick W.	Butte
*Struthers, William A.	Butte
Thompson, A. J.	Butte
*Thompson, Laurence L.	Tilton, N. H.
Willson, Fay G.	Virgille
Woodward, Claudia H.	Butte
Worcester, S. Austin, Jr.	Butte

FRESHMAN CLASS

*Anderson, Paul F.	Sheridan, Wyo.
*Barnum, William McK.	Salt Lake City, Utah
Caldwell, W. Elmer	Butte
*Carlson, Ivar H.	Butte
*Conway, Thomas L.	Butte
Crowley, Dan E.	Butte

Dalton, Bruce E.	Butte
*Day, George B.	Lexington, Mass.
Duckham, William T.	Butte
*Dunstan, James	Butte
*Fisher, L. E. R.	London, England
*Gallagher, Peter B.	Butte
Grant, Earl R.	Leader, Sak. Canada
Giulio, Steve J.	Corbin
*Gussenhoven, Lloyd L.	Havre
*Haggard, Arthur L.	Millboro, S. D.
Harrington, Sam J.	Butte
Havey, Eugene F.	Butte
*Hayes, Lawrence	Butte
*Howarth, Vard O.	Richfield, Utah
Hoem, Harold	Butte
Hunter, Robert G.	Anaconda
Hurley, T. Stephen	Butte
Lage, James E.	Butte
McCafferty, Howard T.	Butte
McGonigle, Charles	Butte
McGrath, Leo J.	Butte
Maury, Jesse L.	Butte
Miller, Edward R.	Butte
*Myers, Walter H.	Butte
O'Brien, William J.	Butte
O'Leary, Stephen J.	Butte
*Oswald, Joe	Bearcreek
*Pippenger, Donald A.	Glasgow
Quinn, John P.	Butte
Redman, John F.	Butte
*Robocker, Merrill	West Salem, Ill
*Rooney, William J.	New York City
Russell, Francis E.	Luther
*Ryan, Dennis V.	Butte
Schmidt, Joseph K.	Anaconda
Shafer, Clarence W.	Sunnyside, Wash.
Steadman, John F.	Butte
Stephens, John R.	Tooele, Utah
Stubbs, Reynolds J.	Salt Lake City, Utah
*Tait, Thomas W.	Howard
Toole, Robert H.	Butte
Townsend, Herbert I.	Hedgesville
*Trimmer, Earl T.	Lehigh
Walsh, Michael R.	Butte
White, James L.	Butte
Word, William F.	Helena

*Military Scholarship.

UNCLASSIFIED STUDENTS.

Coady, Mrs. Leo	Butte
Ericsson, Ida S.	Butte
Henry, V. Russell	Haddonfield N. J.
Kelly, Agatha	Butte
McGandy, Edward L.	Minneapolis, Minn.
Melcher, Evelyn G.	Butte
Wilcox, Frank O.	Butte
Williams, George O.	Butte

SPECIAL STUDENTS.

Allen, Claude	Cornwall, England
Brazzini, Albert H.	Lima, Peru
Griswold, George G., Jr.	Butte

Summary of Registration

	Men.	Women.		
Seniors	9	0		
Juniors	32	0		
Sophomores	38	1		
Freshmen	52	0		
Unclassified Students	4	4		
Special Students	3	0		
	138	5	=	143

Register of Alumni

Adami, Arthur E., 1907 .... Butte, Montana
Associate Professor of Mining Engineering, Montana State School of Mines.
Mining Engineer, Montana State Bureau of Mines.
Aline, Peter A., 1915 .... Great Falls, Montana
Chemist, A. C. M. Co.
Andrew, John T., 1912 .... Butte, Montana
Lawyer.
Archibald, George B., 1905 .... Boise, Idaho
Assistant Commissioner of Reclamation, State of Idaho.
Balmforth, Alfred J., 1904 .... Warren, Arizona
Ventilation Engineer, Calumet & Arizona Mining Co.
Bassett, Arthur F., 1912 .... Detroit, Michigan
Detroit District Manager, Hyatt Roller Bearing Co.
Bender, Louis V., 1903 .... Anaconda, Montana
General Supt. Washoe Reduction Works, A. C. M. Co.
Bovett, C. A., 1907 .... Verdi, Nevada
Bowden, Malcolm, 1908 .... Butte, Montana
Foreman Travona Mine.
Brinton, Owen F., 1905 .... Salt Lake City, Utah
Mining Engineer, Contracting, Consulting Work, Examinations.
Brulo, William, 1909 .... Helena, Montana
Superintendent Investment Dept., Mont. Life Insurance Co.
Cannon, Frank D., 1917 .... Butte, Montana
Shift Boss, Berkeley Mine, A. C. M. Co.
Carlisle, Stanley B., 1917.
Deceased.
Cheung, T. C., 1917.
Christian, Otto B., 1912 .... Los Angeles, Calif.
Cliff, Frank M., 1920 .... Butte, Montana
Engineer, Davis-Daly Copper Company.
Clinch, R. S., 1911 .... Nacozari, Sonora, Mexico
Mining Agency.
Clinch, Walter D., 1912 .... Butte, Montana
Efficiency Engineer, Timber Butte Milling Co.
Cohan, Jesse E., 1912 .... Butte, Montana
Engineering Department, A. C. M. Co.
Cole, Robert J., 1914 .... Butte, Montana
Geologist, W. A. Clark, Jr.
Collins, Thomas F., 1917 .... Catorce, S. L. P., Mexico
Chief Engineer, Geologist, Refugio & Dolores Mines.
Cooke, Hamilton, Jr., 1912 .... St. Louis, Missouri
Agency Organizer, New York Life Insurance Co.
Corey, Clarence R., 1905 .... Seattle, Washington
Assistant Professor of Metallurgy, University of Washington.
Courtney, Edward F., 1919 .... Philipsburg, Montana
Mining Engineer.
Crittenden, Zar T., 1913 .... Pontiac, Michigan
Assistant Metallurgist, Division of Grand Motors, Oakland Motor Car Co.
Cullity, Emmet R., 1912 .... Hot Springs, Arkansas
Mining Examinations, Silver King Mining Co.
Curran, Francis R., 1916 .... Murray, Idaho
Mining Engineer, Bear Creek Mining Co.

Dobson, Chris G., 1913........Seattle, Washington
Instructor, Department of Civil Engineering, University of Washington.
Dugan, John F., 1906........Butte, Montana
Foreman, Nettie Mine, A. C. M. Co.
Duling, J. F., 1904.
Duthie, John M., 1905........Forsyth, Montana
Land Classification.
Elford, Basil E., 1905........Anaconda, Montana
Reverberatory Department, Washoe Smelter, A. C. M. Co.
Eliss, Willis H., 1908........Billings, Montana
Resident Engineer, State Highway Commission.
Engel, A. L., 1919........Sewell, via Rancagua, Chile, S. A.
Junior Milling Engineer, Braden Copper Co.
Evans, James R., 1909........Tshikapa, Congo Belge, West Africa
Mining Engineer with Societe Internationale Firestiere et Minere du Congo.

Feeney, Charles M., 1906.
Deceased.

Foote, Frank A., 1908........Dundu, Angola, via Tshikapa, Congo Belge
Mining Engineer. West Africa.
Fowler, George M., 1912........Butte, Montana
Manager, West Dome Oil Company.
Geologist, A. C. M. Co.
Freshman, Herman A., 1917........Winifred, Montana
Land Classification.
Gaethke, Fred P., 1917........Butte, Montana
Shift Boss, Reins Mine, A. C. M. Co.
Gidel, Murl H., 1912........Butte, Montana
Geologist, A. C. M. Co.
Gieser, H. S., 1906........Anaconda, Montana
Concentrating Engineer, Washoe Reduction Works, A. C. M. Co.
Gilham, Ralph, 1909........Townsend, Montana
Giovanetti, Ettore, 1912........Butte, Montana
Professor at Butte Business College.
Goodell, Luther T., 1915........Seattle, Washington
Pressman, Times Publishing Co.
Grunert, August, 1910........Butte, Montana
Chemist, Butte & Superior Mining Co.
Grupe, Charles W., 1912.
Haines, Peter A., 1909........Rivermines, Missouri
Superintendent, Doe Run Lead Company.
Hale, Emmet, 1920........Butte, Montana
Assistant Geologist, North Butte Mining Co.
Hanson, Wilbur W., 1913........Butte, Montana
Safety and Ventilation Engineer, A. C. M. Co.
Hill, W. J., 1916........Santa Barbara, Chihuahua, Mexico
Chief Engineer, Santa Unit, A. S. S. Co.
Hogan, Eugene, 1916........Butte, Montana
Assistant Foreman, Emma Mine, A. C. M. Co.
Hunt, John E., 1915........Butte, Montana
Flotation Engineer, Timber Butte Milling Co.

Ireland, Arthur J., 1904.
Deceased.

Jensen, Walter H., 1910........Great Falls, Montana
Secretary-Treasurer, Montana Brewing Company.
Johns, John W., 1906........Marysville, Montana
Superintendent, Shannon Mine, Barnes-King Dev. Co.
Johnstone, J. Clark, 1909........Butte, Montana

Kane, Edward G., 1909........Butte, Montana
Mine Foreman, Bell Mine, A. C. M. Co.
Kane, Louis M., 1906.
Deceased.
Ketcham, S. H., 1908........Missoula, Montana
Private Practice, Engineering.
Kirby, Kenneth P., 1909........Butte, Montana
Mining Engineer, Anaconda Mine, A. C. M. Co.
Kuphal, Henry E., 1904........Boise, Idaho
Lind, A. Leslie, 1916........Butte, Montana
With Butte Stove Repair Co.
Ling, Tao, 1917........Hong Kong, China
Teaching.
Loman, E. Percy, 1908........Butte, Montana
President, Butte East Slope Mining Co.
Loughran, David L., 1918........Butte, Montana
Assistant County Surveyor, Silver Bow County, Montana.
Loughran, M. J., 1909........Butte, Montana
County Surveyor, Silver Bow County, Montana.
Lowry, T. M., 1909........San Francisco, California
Geologist, Standard Oil Company of California.
Lyden, Joseph P., 1914........Butte, Montana
Geologist, A. C. M. Co.
Lyon, Thomas T., Jr., 1916........Butte, Montana
Geologist, Oil Department, A. C. M. Co.
McAuliffe, D. Charles, 1920........Forsyth, Montana
Draftsman—Land Classification.
McCool, Edward J., 1913........Butte, Montana
Safety-First and Ventilation Engineer, A. C. M. Co.
McCracken, Ralton H., 1907........Philipsburg, Montana
Engineer.
McElvenny, L. T., 1911........Butte, Montana
Assistant City, Engineer, Butte, Montana.
McGee, John, 1904........Tonopah, Nevada
General Manager, Water Company, Tonopah.
McLaughlin, William D., 1908........Butte, Montana
Surveyor, Tramway Mine, A. C. M. Co.
McMahon, Brandon P., 1914........Butte, Montana
Assistant Assayer, North Butte Mining Co.
Mackel, Louis C., 1905........Santa Fe, New Mexico
Mineral Examiner, General Land Office.
MacPherson, Frank H., 1914........Butte, Montana
Safety Engineer, A. C. M. Co.
MacRae, L. D., 1904........Nacozari, Sonora, Mexico
Engineer, Moctezuma Copper Co.
Malloy, Emmett E., 1909........Miles City, Montana
Emmett E. Malloy & Co., Land Classifiers.
Manwaring Joseph H., 1913........Butte, Montana
Mason, Veyne V., 1916........Butte, Montana
Boss Trammer, Tramway Mine, A. C. M. Co.
Meiklejohn, Archie B., 1908........Los Angeles, California
Distribution Accountant, Southern California Edison Co.
Milkwick, C. F., 1919........Anaconda, Montana
Chemist, Washoe Reduction Works, A. C. M. Co.
Mueller, Ernest, 1920........Anaconda, Montana
Murphy, James Kane, 1911........Anaconda, Montana
Asst. Supt., Anaconda Reduction Works, A. C. M. Co.
Murphy, Joseph G., 1914........Seattle, Washington
Sales Engineer, Worthington Pump Machinery Corporation.
Operating Lease on Cave Mine, Bayhorse, Idaho.

Nelson, A. S., 1918..........Leadwood, Missouri
Testing Engineer, St. Joseph Lead Company.
Newton, Claude O., 1919..........Cerro de Pasco, Peru, S. A.
Mining Engineer with Cerro de Pasco Mining Corporation.
Newton, Lucian, 1913..........Shoupe, Idaho
Superintendent Kentuck Mining Co.
Norton, John E., 1917..........New York City
Student, Columbia University.
O'Brien, Albert, 1908..........Butte, Montana
Mining Engineer.
O'Connor, C. H., 1911..........Butte, Montana
In Testing Department, Timber Butte Milling Co.

Parker, W. Howard, 1917.
Deceased.

Patten, Earle B., 1908..........Philipsburg, Montana
Mining Engineering, Private Practice.
County Surveyor, Granite County.
Pauley, P. L., 1904..........Butte, Montana
Peters, Ira B., 1909.
Peterson, P. E., 1911..........Cassidys', V. I., British Columbia
Superintendent of Concentration, Granby Consolidated Mining, Smelting and Power Co., Ltd.
Petritz, Willim E., 1918..........Butte, Montana
Shift Boss, Reins Mine, A. C. M. Co.
Pierce, Wilbur C., 1919..........Great Falls, Montana
Chemist, General Laboratory, A. C. M. Co.
Pierse, Edwin A., 1913..........Great Falls, Montana
Concert Master, Robin Hood Opera Co.
Pilger, Theodore, 1912..........New York, N. Y.
Sales Engineer, Allis Chalmers Mfg. Co.
Pratt, A. F., 1913..........Portland, Oregon
Lawyer.
Pratt, Paul D., 1905..........Helena, Montana
Member of the firm of Western Construction Company, General Contractors.
Proctor, M. D., 1908..........Truly, Montana
McNair & Proctor Ranch Co.
Proctor, I. O., 1908..........Butte, Montana
Millman Foreman, Timber Butte Milling Co.
Reardon, D. J., 1907..........Butte, Montana
Member of firm of Medin & Co., General Contractors.
Reber, Bert A., 1915..........Grass Valley, California
Reese, Mrs. Clara Clark, 1904..........Los Angeles, California
Reid, Milton A., 1913..........Butte, Montana
Chief Chemist, Washoe Sampler.
Renouard, Edward I., Jr., 1920..........Butte, Montana
Engineering Dept., A. C. M. Co.

Roach, James, 1911.
Deceased.

Schaefer, W. A., 1907.
Deceased.

Schiffner, O. E., 1908..........Broken Hills, Nevada
Superintendent.
Sheedy, John W., 1915..........Kingman, Arizona
General Mill Foreman, C. O. D. Mines.
Shields, E. Floyd, 1911..........Butte, Montana
Superintendent Crystal Copper Co.
Sparks, Karl T., 1917..........Fairbanks, Alaska
Mining Engineer, United States Bureau of Mines.

Steele, Chester H., 1916 .... Butte, Montana
Geologist, A. C. M. Co.

Stevenson, Isabel Little, 1904 .... Roland Park, Richmond, Virginia
Credit Department, Federal Reserve Bank.

Stevenson, L. C., 1905.
Deceased.

Stockett, Norman A., 1909 .... Bonne Terre, Missouri
Engineering Dept., St. Joseph Lead Co.

Strang, Willis B., 1916 .... Musselshell, Montana
Mining Engineer and Top Foreman, Star Coal Co.

Stuewe, William, Jr., 1910 .... Spokane, Washington
Sales and Structural Engineer, Minneapolis Steel and Machinery Co.

Sultzer, H. Duke, 1911 .... Butte, Montana
Ventilation and Safety Engineer, Tramway Mine, A. C. M. Co.

Tallant, Harry S., 1904 .... Palma Sola, Florida
Farmer.

Ternouth, Blaine, 1914 .... San Francisco, California
Electrician, W. J. Benson Company.

Thrasher, Williard, 1918 .... Butte, Montana
Geologist, North Butte Mining Co.

Tout, Charles, 1911 .... Butte, Montana
Burgess & Tout, Mining Engineers.

Tsea, G. B., 1917 .... Nanchong, Kiangse, China
Mining Director of the Industrial & Mining Bureau of Kiangse.

VanGundy, Jay E., 1905 .... Roundup, Montana

Vaupell, C. W., 1920 .... Butte, Montana
Geologist, A. C. M. Co.

Villars, Jesse R., 1908 .... Great Falls, Mont.
Oil and Mining Geologist.

Vivian, George F., 1917 .... Butte, Montana
Sampler, Nettie Mine, A. C. M. Co.

Walton, Lee M., 1908 .... Great Falls, Montana
Manager, Wardrobe Company.

Warfield, H. J. 1906 .... Los Angeles, California
Sales Manager, Southern California Farms.

Watson, Robert M., 1915.
Deceased.

Wiegenstein, Henry J., 1909 .... Butte, Montana
Commissioner of Publiic Works, City of Butte.

Wilkinson, Thomas H., 1917 .... Butte, Montana
Assistant Foreman, Reins Mine, A. C. M. Co.

Williams, Paul K., 1912 .... Butte, Montana

Wilson, Curtis L., 1920 .... Anaconda, Montana
Asst. Research Engineer, Anaconda Reductionn Works, A. C. M. Co.

Wilson, T. Bert, 1906 .... Goldendale, Washington
Manager of Goldendale Garage.

Wong, Samuel C., 1916 .... Honolulu, H. I.
Computist, Standard Oil Co. of New York.

Woodworth, Guy T., 1915 .... Great Falls, Montana
Oil Exploration Branch, Geological Dept. A. C. M. Co.

Wren, Andrew A., 1908 .... Patagonia, Arizona
Superintendent Patagonia Superior Mining Co.

Young, Arthur B., 1906 .... Canille, Arizona
Forestry Service, U. S. Dept. of Agriculture.

Young, S. A., 1906 .... Astoria, Oregon
Private Practice.

Young, William A., 1909 Lessee Maginnis Mine.	Maiden, Montana
Zentner, Arthur A., 1911 Research Engineer, Zinc Plant, A. C. M. Co.	Great Falls, Montana

Register of Alumni by Classes

1903

L. V. Bender.

1904

A. J. Balmforth, Clara Clark (Reese), J. F. Duhling, Arthur L. Irelan, Henry E. Kuphal, Isabel Little (Stevenson), L. D. MacRae, John McGee, P. L. Pauley, H. S. Tallant.

1905

George Achibald, O. F. Brinton, Clarence R. Corey, J. M. Duthie, Basil Elford, L. C. Mackel, P. D. Pratt, L. C. Stevenson, Jay Van Gundy.

1906

J. F. Dugan, Charles W. Feeney, Herbert S. Gieser, John W. Johns, Louis N. Kane, Hershel J. Warfield, Bert T. Wilson, S. A. Young, Arthur B. Young.

1907

Arthur E. Adami, Clifford A. Bovett, Ralston H. McCracken. Daniel Reardon, W. A. Schafer.

1908

Malcolm Bowden, Willis H. Ellis, Frank A. Foote, S. H. Ketcham, E. P. Lomas, T. M. Lowry, William D. McLaughlin, Archie B. Meiklejohn, Albert O'Brien, Earle B. Patten, I. O. Proctor, M. D. Proctor, Otto E. Schiffner, Jesse R. Villars, Lee M. Walton, A. A. Wren.

1909

William Brulo, James R. Evans, Ralph Gilham, Peter A. Haines, J. Clark Johnstone, Edward G. Kane, Kenneth P. Kirby, Michael Loughran, Emmett E. Malloy, Ira B. Peters, Norman A. Stockett, Henry J. Wiegenstein, William A. Young.

1910

August Grunert, Walter H. Jensen, William Stuewe, Jr.

1911

R. S. Clinch, L. T. McElvenny, James K. Murphy, C. H. O'Connor, P. E. Peterson, James Roach, E. Floyd Shields, H. D. Sultzer, Charles Tout, Arthur A. Zentner.

1912

J. T. Andrew, Arthur F. Bassett, Otto B. Christian, Walter D. Clinch, Jesse E. Cohan, Hamilton Cooke, Jr., Emmet R. Cullity, Geo M. Fowler, Murl H. Gidel, Ettore Giovanetti, Charles Grupe, Theo. F. Pilger, Paul K. Williams.

1913

Zar T. Crittenden, Chris G. Dobson, Wilbur W. Hanson, Edw. J. McCool, Joe H. Manwaring, Lucian Newton, Edwin A. Pierse, A. F. Pratt, Milton A. Reid.

1914

Robt. J. Cole, Joseph P. Lyden, Brandon McMahon, Frank H. MacPherson, Joseph G. Murphy, Blaine Ternouth.

1915

Peter A. Aline, Luther T. Goodell, John E. Hunt, Bert A. Reber, John W. Sheedy, Robert A. Watson, Guy T. Woodworth.

1916

F. R. Curran, William J. Hill, Eugene Hogan, A. Leslie Lind, Thomas T. Lyon, Jr., Veyne V. Mason, Chester H. Steele, Willis B. Strang, S. A. Wong.

1917

Frank D. Cannon, Stanley B. Carlisle, T. C. Cheung, Thomas F. Collins, Herman Freshman, Fred P. Gaethke, Tao Ling, John E. Norton, Howard Parker, Karl T. Sparks, G. B. Tseo, George F. Vivian, Thomas Wilkinson.

1918

David E. Loughran, A. S. Nelson, William E. Petritz, Willard Thrasher.

1919

Edward F. Courtney, A. L. Engel, Clifford F. Milkwick, Claude O. Newton, Wilbur C. Pierce.

1920

Frank M. Cliff, Emmett Hale, D. Charles McAuliffe, Ernest Mueller, Edw. I. Renouard, Jr., C. W. Vaupell, Curtis L. Wilson.

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Each series of the Bulletin is issued quarterly, and contains annual reports, catalogues, etc.

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1921-1922

ANNOUNCEMENTS FOR
1922-1923

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BUTTE, MONTANA
JULY, 1922

THE UNIVERSITY OF MONTANA

Edward C. Elliott, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913):

The general control and supervision of the University are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

MONTANA STATE BOARD OF EDUCATION

J. M. DIXON, Governor - - - - - - - - Ex-officio, President
W. D. RANKIN, Attorney General - - - - - Ex-officio
MAY TRUMPER, Superintendent of Public Instruction Ex-officio, Secretary

A. J. VIOLETTE - - -	(1922)	WHITFIELD SPAIN - - -	(1924)
JUDGE SIDNEY SANNER	(1922)	J. W. FREEMAN - - - -	(1924)
C. H. FOOT - - - - - -	(1923)	JOHN DIETRICH - - -	(1925)
R. C. LINE - - - - - -	(1923)	FRANK ELIEL - - - -	(1925)

The State University, Missoula

Established February 17, 1893, and Consisting of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The School of Education
The School of Business Administration
The Summer Quarter
The Biological Station (Flathead Lake)
The Public Division
Special War Courses—
  Military Service Course (one year)
  Nurses' Preparatory Course (one year)
  Office Training Course (one year)
The Graduate Division

Charles H. Clapp, President

The State College of Agriculture and Mechanic Arts, Bozeman

Established February 17, 1893, and Consisting of

The College of Agriculture
The College of Engineering
The College of Applied Science
The College of Household and Industrial Arts
Courses for Vocational Teachers
The School of Music
The Summer Quarter
The Agricultural Experiment Station
The Agricultural Extension Service
The Secondary Schools—
  Home Economics
  Mechanic Arts
  Agriculture
Special War Courses—
  Military Service Course (one year)
  Nurses' Preparatory Course (one year)
  Office Training Course (one year)

Alfred Atkinson, President

The State School of Mines, Butte

Established February 17, 1893

The State Bureau of Mines and Metallurgy
George W. Craven, President

The State Normal College, Dillon

Established February 23, 1893, and Consisting of

The Teachers' Certificate Course
The Three-Year Course
The Four-Year Course
The Rural Teachers' Course
The Course for Supervisors

Sheldon L. Davis, President

For publications and detailed information concerning the different schools and colleges address the president of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

UNIVERSITY OF MONTANA BULLETIN

SCHOOL OF MINES SERIES NO. 4

STATE SCHOOL OF MINES

TWENTY-SECOND ANNUAL CATALOGUE

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School Calendar 1921-1922

1922

SUMMER WORK

June 5, Monday, Mine Surveying begins.
June 17, Saturday, Mine Surveying ends.
August 21, Monday, Field Work in Plane Surveying begins
August 28, Monday, Field Work in Geology begins.
September 16, Saturday, Summer Field Work ends.

FIRST SEMESTER

September 18, Monday, First Semester begins.
November 30, Thursday, Thanksgiving Day, holiday.
December 23, Saturday, Christmas Recess begins.

1923

January 8, Monday, Christmas Recess ends.
February 2, First Semester ends.

SECOND SEMESTER

February 5, Monday, Second Semester begins.
May 30, Tuesday, Memorial Day, holiday.
June 8, Friday, Commencement Day, Second Semester ends.

SUMMER WORK

June 11, Monday, Mine Surveying begins.
June 23, Saturday, Mine Surveying ends.
August 20, Monday, Field Work in Plane Surveying begins
August 27, Monday, Field Work in Geology begins.
September 15, Saturday, Summer Field Work ends.
September 17, Monday, First Semester begins.

Official Directory

EXECUTIVE BOARD

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M. S., School of Mines, University of Missouri
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A. M., University of Wisconsin

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B. A., Macalester College
M. A., University of Wisconsin
Ph. D., University of Wisconsin

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Director of Student Activities
A. B., Westminster College of Pennsylvania
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B. S. Coe College
B. E. E., University of Iowa

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B. S., School of Mines, University of Utah

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CHARLES M. BLACKBURN - - - - - - - - - - - - Mathematics
B. S., Carnegie Institute of Technology

B. E. THOMAS - - - - - - - - - - - - - - - - - - Spanish
Platville State Normal College, Wisconsin
U. S. Government Interpreter in Spanish, 1900-1910

CHESTER M. PITTSER - - - - - - - - - - Coach of Athletics
Colorado School of Mines

CURTIS L. WILSON - - - - - - - - - - - - - - - Metallurgy
E. M. Montana State School of Mines

Assistants

M. F. HALEY - - - - - - - - - - - - - Assistant in Mill Work

University of Montana

An Act of Congress, approved February 18, 1881, dedicated for university purposes in Montana seventy-two sections of the public domain. The Enabling Act, providing for the organization of the State of Montana and its admission to the Union, February 22, 1889, confirmed this grant to the State and added 100,000 acres for a school of mines, 100,000 acres for normal schools, and 140,000 acres for an agricultural college.

The Third Legislative Assembly of the State of Montana, in February, 1893, enacted laws providing for the establishment of all these institutions, and locating the State University at Missoula, the State School of Mines at Butte, the State Normal School at Dillon, and the State Agricultural College at Bozeman.

As the lands granted for higher educational purposes, together with timber or stone thereon, have been sold, the proceeds have gone into permanent funds, invested for the various institutions, and the interest on these funds, together with the rentals of unsold lands, has been used for the support of the respective institutions. These maintenance resources have been supplemented with appropriations made each subsequent biennium by the Legislative Assembly, which has also provided for the erection of buildings at the expense of the State.

These institutions were administered independently by local executive boards for some years under the general supervision of the State Board of Education; by a law of 1909 the powers of the local boards were more closely defined, and the direction of the State Board of Education made more effective. By the enactment of Chapter 92 of the Laws of the Thirteenth Legislative Assembly in 1913, the four institutions were combined into the University of Montana under the executive control of an officer, whose title is Chancellor. In October, 1915, the State Board of Education appointed Edward C. Elliott, then of the University of Wisconsin, as the first Chancellor of the University of Montana. He assumed his duties February 1, 1916.

At the general elections in November, 1920, the voters of the State, by a large majority, enacted, through the popular initiative, two measures for the financial support and development of the University of Montana. The first of these measures levies a tax of one and one-half mills on all the taxable property in the state annually for ten years for the maintenance of the University of Montana; the second provides for a State bond issue, from the proceeds of which three and three-quarters million dollars become available for the erection and equipment of buildings at the several institutions of the University of Montana.

State School of Mines

The establishment of the State School of Mines, in Butte, was supervised by a commission appointed in 1895, consisting of F. E. Sargent, John Gillie, W. W. Dixon, J. H. Leyson and C. W. Goodale. The lands of the School of Mines were used as a basis for the issue of bonds amounting to $120,000.00, and in 1896 the erection of the main building was begun. An additional appropriation of $26,300.00 was made in 1899 for equipment and maintenance. The school actually opened September 11, 1900, and the first class graduated in June, 1903.

The proceeds from the sale of the lands of the School of Mines have gone into a permanent fund, the interest from which, together with the rentals from unsold lands, has provided the school in recent years with most of its ordinary operating and capital expenditures. In 1907, $50,000.00 was appropriated for a new heating plant and mill buildling, and in 1910, $15,000.00 was appropriated for a gymnasium.

Nathan R. Leonard, Professor of Mathematics, was the first President of the institution. He was succeeded in 1906 by Charles H. Bowman, Professor of Mathematics, who had been connected with the school since its beginning. In 1918, President Bowman was granted a year's leave of absence, and Charles H. Clapp, Professor of Geology and Mineralogy, was appointed Acting President. Upon President Bowman's resignation in 1919, Professor Clapp became President. In 1921, when President Clapp was transferred to the Montana State University as its President, George W. Craven, Professor of Mathematics and Mechanics, was selected to succeed him.

PURPOSE AND SCOPE

The School of Mines has strictly confined itself to the preparation of young men for the mining profession, and by so doing has maintained a very high standard in this field. Before the war ninety per cent. of its graduates were engaged in engineering work, very largely in Mining Engineering, and moreover, many of its graduates hold positions of great responsibility. Although the distinction between a purely vocational school and an engineering college has always been kept clearly in mind, the school has given its students a practical knowledge of mining subjects, as well as a thorough education in theoretical principles. The fundamental subjects for all forms of engineering are given and special emphasis is laid upon the three main branches of mining—geology, mining and milling, and metallurgy.

LOCATION AND SURROUNDINGS

The State School of Mines is located just inside the western city limits of Butte. The site, on the southern bench of Big Butte, the extinct volcano which dominates the city, and from which the city takes its name, was donated by certain public-spirited citizens. It is easily accessible, since the street cars run within two blocks. The location is most commanding, and the view from the grounds overlooks the city, mines, and smelters, as well as the mountains which form the Continental Divide, and which surround on the east and south the valley in which the city is situated.

It is no longer necessary to call attention to the fact that Butte is one of the greatest mining centers of the world. The discoveries and developments of the years past and the enormous investment of capital in the mines of this city by the leading financiers and mining men of this country and Europe have given this locality such publicity that no one needs to be told of its leading position in the mining world.

In Butte are to be found, not only some of the largest copper and zinc mines in the world, but great mills and reduction plants. These are being continually enlarged and improved to meet the demands of greater industry. In addition, Butte is the site of other great engineering enterprises, and in few other places is there such an assemblage of machine shops, factories, and power plants as are to be found in the vicinity of the school. The city is, therefore, especially well fitted to meet the needs of a mining school.

In a very important sense all of these plants are a part of the substantial equipment of the school, because its pupils are brought into daily contact with the men who are personally engaged in the various departments of the mining and engineering industry and who are thoroughly conversant with the details of the work.

BUILDINGS

The main building, erected during 1895 to 1897, is a four story pressed brick building. It measures one hundred and eighteen feet by ninety-four feet, and contains 37,000 square feet of floor space. In the basement are the chemical, metallurgical and mechanical testing laboratories. The next two floors contain the recitation rooms, drafting rooms, mineralogy laboratory, and library. The fourth floor is devoted chiefly to museums, which contain extensive collections of minerals, ores and mine models. In addition, there is also on this floor a petrograph laboratory and a blue print room.

In the rear of the main building is the mill building, completed in 1908. This building measures seventy feet by one hundred and ten feet. It contains the steam and electric power plant which heats the buildings and supplies power to the mill and laboratories. The mill is equipped to handle large quantities of ore conveniently, and affords treatment of ores by most of the standard processes now in practice.

The gymnasium building, to the north of the main building, was erected in 1910. It measures eighty-seven feet by fifty feet and contains a large gymnasium hall seventy feet by forty-five feet. At one end of the gymnasium is a balcony with a seating capacity for one hundred. The hall itself is used on special occasions as a general auditorium. Connected with the gymnasium are two parlors, a dressing room, and in the basement are the shower baths.

A new chemistry and metallurgical building is in course of erection and will be ready for occupation during the year 1922-1923. When complete it will cost $200,000.00 and will be thoroughly well equipped for its purposes.

The development program for the School of Mines has in prospect for the next few years the erection of an engineering building, a new gymnasium, and an administration hall and library, the remodeling of the present mill building, and the grading and equipping with seats of a new athletic field. Funds for this will come largely from the bond issue voted by the people of the state at the general election in November, 1920.

EQUIPMENT

The equipment of the School of Mines has been secured through appropriations made by the Legislature of Montana. The total sum invested for this purpose now amounts to $75,000, and represents a careful selection of the latest and best apparatus for the different departments of the School.

Department of Mathematics

The work in this department is to lay a solid foundation for a large part of the scientific discussions which are necessarily connected with all branches of the study of engineering. The department is furnished with large recitation and lecture rooms on the first floor of the Main building, and has all the apparatus necessary for teaching the subjects required.

Department of Mechanics

The department of mechanics occupies three rooms on the first floor of the Main building. The lecture room has a seating capacity of forty persons and is provided with the modern lecture room conveniences. The lecture apparatus consists of a select equipment for illustrating the laws of mechanics, electricity, sound and light. The physics laboratory is housed temporarily in the old S. A. T. C. barracks building, and is equipped with the necessary heavy tables and apparatus for the measurements of density, elasticity, force of gravity, latent heats of fusion and evaporation, mechanical equivalents of heat and light, and electricity.

Mechanics Laboratory

The mechanics laboratory is located in the basement of the Main building and in the Mill building. Its equipment includes electric motors, direct and alternating current dynamos, a mercury arc rectifier, a

50 K. W. generator, a complete switchboard, many instruments used in electrical work, two 80-horsepower boilers and a 75-horsepower high-speed engine illustrating steam power, and an air compressor. There are also a 100,000-pound Olson machine with accessories for tensile, compression, and shearing tests, and a Fairbanks, Morse & Co. outfit for cement tests, as well as apparatus for other tests. A small shop fitted with metal-working machines and a blacksmith shop complete the laboratory.

Department of Chemistry.

A great part of the basement floor of the Main building, together with a lecture room on the first floor, has been devoted to the use of the department of chemistry. Included in this arrangement are a qualitative and quantitative analysis laboratory, two special laboratories, a metallurgical laboratory, a store room, a dispensary where the prepared tests for students are kept, and a dark room for photographic work, spectrum analysis, and making blue-prints and lantern slides.

Department of Metallurgy

An assay laboratory and a metallurgical laboratory comprise the main equipment for the department of metallurgy. The assay laboratory is situated on the basement floor of the Main buildling and has six coal assay furnaces and electrical furnaces for special work, cyanide outfits, and a calcining furnace. Adjoining is a pulp room. Also there is a crusher room provided with a Gates crusher and a Low crusher, a grinder, a pulverizer, a bucking board, and other necessary equipment. Copper, lead, gold, and silver ores are easily assayed here.

The metallurgical laboratory is located in the Mill building, about one-third of which is used for this purpose, while the rest is given over to ore dressing, the central heating plant, and the motor and dynamo room. The laboratory contains a cyanide plant which can handle ore in five-ton lots, a mechanically rabbled Wedge furnace used as a reverberatory or muffler furnace in roasting ores in one-ton lots, and a complete laboratory size Dwight-Lloyd sintering machine.

Mining and Ore Dressing

Two lecture and drawing rooms and an office and store room are provided in the Main building for instruction in mining and ore dressing. The equipment includes all the varied instruments used in practical surveying, both for feld and mine work, in sufficent number for student use. Large collectons of blue prints, the finest college collection of mine models in the United States, ores in various stages, and bulletins on mining, milling and smelting ores are also at the disposal of students.

The ore-dressing laboratory is in the Mill building, and is so arranged that complete tests on a commercial scale can be made on various kinds of ore. The mill includes a crusher, rolls, belt elevators, trommels, screens, an Evans jig and a Hartz jig, a Huntington mill, a Wilfley table, a Diester-Overstrom concentrator, a Diester concentrator slimer, a Frue vanner, a Dings magnetic separator, a three-stamp mill, and such accessories as classifires, settling tanks and centrifugal and water pumps. There is also a miniature testing plant which will handle ore in quantities up to four pounds.

Department of Geology and Mineralogy

This department occupies a lecture room, a mineralogical laboratory, and an office on the second floor of the Main building and two museum rooms, a petrographic laboratory, and a storage room on the third floor. An unusually large and complete collection of minerals is maintained, part as student hand specimens and part under glass for observation only. All told, the museum contains well over ten thousand specimens, being especially well supplied with samples from Montana, but also having rocks, minerals, and fossils from all over the world. An extensive collection of real and model chrystals, of maps and charts, and of mine models, the last named used originally in mine litigation in Butte, are employed in class room teaching. The mineralogical and petrographic laboratories contain the apparatus necessary for making tests on rocks, including grinding lathes, petrographic microscopes, cameras and other instruments and materials too numerous to mention. The department also has on hand all the necessary instruments for field work and owns three complete camping outfits.

THE LIBRARY

Charlotte Russel, Librarian

The library is located on the second floor of the Main building, its windows facing the main range of the Rocky Mountains and overlooking the famous Anaconda Hill. It is a large, well-lighted room and offers, with its alcoves, a convenient and quiet place for students' study and leisure hours.

The number of publications in the library, departmental and others, is nearly 9,000. As a United States Depository for Public Documents, the shelves contain the issues of the United States Geological, Coast and Geodetic Surveys; Reports on Forestry, Forest Reserves and Irrigation; of the Naval Observatories, Engineering Corps, and Bureau of Mines. Besides these, the library receives the official scientific reports of various state surveys, and of Mexico, Canada, Great Britain, France, Norway, Cape of Good Hope, New Zealand, and the states of Australia. In addition to this abundance of technical and scientific literature all the most important standard reference works are procured as they are published.

The leading scientific, mining engineering, geological and literary magazines are to be found on the library tables, and as fast as the several volumes of these are completed they are bound, and thus furnish, in permanent form, more or less complete discussions of the latest and most important advances that have been made in their several departments. To these are added the bound volumes of the proceedings of the great scientific societies, such as the Geological Society of America, the American Chemical Society, and the American Institute of Mining Engineers, and the periodical issues of other colleges.

EXPENSES OF STUDENTS

FEES AND DEPOSITS

No charge of tuition is to be made where the student is a bona fide resident of Montana. From and after September 1. 1923, all students not residents of the state of Montana, unless matriculated before that date in the institution in which they register, will be required, in addition to all other fees, to pay a special non-resident fee of $25.00 per quarter (or $37.50 per semester). No person will be considered eligible to register as a resident of the state of Montana unless he has resided in the state for the twelve months next preceding the date of proposed registration, and no person will be considered to have gained residence in the state while a student of the University of Montana unless or until his parents move into the state and acquire bona fide residence there.

A registration fee of $5.00 each semester will be required of all students. No deduction will be made to those who attend for only part of the semester.

By vote of the student body a student activity fee of $10.00 is asked from each student who registers. The proceeds from this fee are used as the necessary financial guarantee for athletics. In return for this payment, the student will be admitted without further charge to all contests held under the direction of the student body.

To secure the State against loss for apparatus that may be broken or damaged by the students, a deposit is required at the beginning of the year from each one engaged in laboratory work.

This deposit is placed in the hands of the Treasurer of the Board of Trustees. Each student is charged with the apparatus issued to him. At the close of the year he is credited with such articles as he returns in good order, and the balance of this account is then returned to him.

The following is a list of deposits that are required:

Freshman Year

General Chemistry	$15.00

Sophomore Year

Plane Surveying	$10.00
Quantitative and Qualitative Analysis	15.00

Junior Year

Mine Surveying	$10.00
Assaying, Laboratory	10.00
Mineralogy	10.00
Electro and Physical Chemistry	10.00

Senior Year

Metallurgy	$15.00

When the breakage exceeds the deposits the student will be required to make good the full amount of the damage done.

BOARD AND ROOM

There are no dormitories connected with the School. Students will be expected to find board and lodging for themselves in Butte or vicinity, and at such places as are approved by the faculty. The expense for board and lodging is not higher than in other important cities of the west. Good board can be secured at $30.00 to $35.00 per month, while the cost of a good room, large enough for two persons, and including light and heat, will be from $15.00 to $25 00 per month, according to the location and the furnishings. Cost of text-books averages about $25.00 a year. Freshmen will also need a set of drawing instruments, which cost approximately $20.00. For those who find it necessary to economize, there are few cities that afford as favorable opportunities for self-help as are found here.

RAILROAD FARE REFUNDS

In accordance with the provisions of Chapter 123, of the Session Laws of 1917, and under regulations established by the State Board of Education, railroad fare in excess of five dollars, actually paid by any student for a round-trip between his Montana home and any institution of the University of Montana once each year, will be refunded. No war tax paid by any student will be refunded under any circumstances whatever.

REQUIREMENTS FOR ADMISSION

Applicants for admission must be at least sixteen years of age and must present evidence of good moral character.

The completion of a high school or preparatory course of four years is the standard for regular entrance. This must include at least fifteen units of work. A unit is the amount of work required by the successful completion of one subject pursued for a school year of not less than thirty-six weeks, with five recitations per week, each recitation period being not less than forty-five minutes each. Two periods of laboratory, shop, or drawing work count as one recitation. The required units must include three units in English composition and literature, one in American history and government, one in physics, and three in mathematics distributed between algebra and plane and solid geometry.

Graduates of any Montana high school or academy fully accredited by the State Board of Eduation, or of any high school or academy in another state accredited by the North Central Association, are admitted to regular standing by the presentation of an official certificate of graduation.

Graduates of any other secondary schools outside of Montana are admitted on the presentation of an official certificate of graduation, if the school maintains, on the basis of regular inspection, accredited relationship with the state university or other university within the state included in the membership of the Association of American Universities.

Any other person must, in order to be admitted to regular standing, pass a satisfactory examination on not less than fifteen* units of secondary school work; provided, that any graduate of a Montana high school accredited by the State Board of Education for the work of only one, two, or three years, may receive entrance credit without examination upon such work as has been successfully completed in such accredited courses as shown by official certificates.

Those who expect to take entrance examinations must notify the Registrar in advance, stating what subjects they desire to offer by examination. For the academic year 1922-1923 the examination days are September 16 and January 27.

ADMISSION BY TRANSFER FROM OTHER COLLEGES AND UNIVERSITIES

Students entering from other colleges, universities, or schools of mines must bring certificates of honorable dismissal. Upon presentation of proper certificates they will receive advanced credit for courses taken in institutions of approved standards.

CONDITIONAL ADMISSION

The entrance requirement of graduation from a four years accredited high school course, including at least fifteen units of credit, may be modified in individual cases by permitting the conditional admission of a student if he has at least fifteen entrance units and has been in regular attendance in a fully accredited high school for four years. To acquire regular standing such a student must present a total of sixteen entrance units. He must make up the number lacking within one year from the date of his first registration.

SPECIAL STUDENTS

Students twenty-one years of age or over, not candidates for degrees, may be admitted without the usual entrance units as special students, if they give satisfactory evidence that they are prepared to pursue successfully the special courses desired. Special students may acquire status as regular students upon complying with the rules applicable to such cases.

HIGH SCHOOL HONOR SCHOLARSHIPS

In order to promote the attendance of students of ability and promise upon the several institutions of the University of Montana, it is the declared policy of the State Board of Education to provide for the awarding of scholarships to be known as High School Honor Scholarships to graduates of the accredited public high schools of the State.

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*These fifteen units must include three units of English composition and literature and one unit of American history and government. No less than one full unit in any subject will be accepted, and a student offering foreign language as a part of his preparation must present at least two units in one language.

The principal of each fully accredited high school in the State may nominate from each year's graduating class from one to four members, depending upon the size of the class (but not more than two for any institution), to be the recipients of high school honor scholarships. These scholarships exempt the holders from the payment of the customary fees in any of the institutions of the University of Montana. Blanks for the nomination of scholars, with detailed statement of conditions, will be furnished to the principals.

AGRICULTURAL CLUB SCHOLARSHIPS

Upon notice from the State Leader of Boys' and Girls' Agricultural Clubs of the awards of the annual club contests, the Chancellor will authorize the issuance of Agricultural Club Scholarships to the winners of first place in any agricultural club contests in any County in Montana, and to winners of first, second, and third places in the State Agricultural Club contest. These scholarships exempt the holders from the payment of the customary fees in any of the institutions of the University of Montana.

CREDIT FOR WAR SERVICE

Credits toward the degrees of the college will be granted for definite and measurable attainments of mind resulting from service in the army and navy of the United States. The number of credits allowed for military service will be determined by the instructor in the branch in which application for credits is made, subject to approval of the committee on military credit and advance standing. Application for war service credits must be made by the student not later than twelve months after his discharge from service.

ADMISSION AS "WAR SPECIALS"

All students who have been in the military service may be admitted as "War Specials," regardless of high school graduation, upon the presentation of satisfactory evidence that they can carry the work successfully. "War Specials" may acquire status as regular students and become candidates for degrees after carrying one full year's work successfully and upon complying with the rules of graduation.

REQUIREMENTS FOR GRADUATION

The School confers the degrees of Mining Engineer and Metallurgical Engineer upon those who have completed the courses as outlined in the following pages.

Students who finish a certain part of the course, such as surveying, assaying, or mechanical drawing, will receive certificates stating what work they have completed.

MISCELLANEOUS INFORMATION

SCHOLARSHIP AND CONDUCT

The School of Mines requires all its students to conform to the usual standards of society and law-abiding citizenship, and to manifest a serious purpose by maintaining satisfactory standing in the courses which they undertake. No student will be permitted to continue his connection with the school who shows persistent unwillingness or inability to comply with these requirements.

Prompt attendance is required of all students at the regular class exercises and satisfactory excuses must be rendered to the instructor in charge for all absences from his class. If the total number of absences, excused or unexcused, in any class exercise amounts to one-fifth of the total number required for the semester, the student may be debarrd from further attendance in that class or department of study.

SCHOLARSHIP GRADES

Each student shall receive a final mark at the end of each semester. The passing grade shall be seventy per cent. If a student's grade in any subject shall fall below fifty-five per cent., the grade registered shall be "failed," and the work must be repeated in class. Also, further attendance in that line of study, if it is a study continued to another semester, must be discontinued until the passing grade is obtained on the work which was a failure. In case a student's grade in any subject falls between fifty-five and seventy per cent., he is conditioned in that subject, but may continue and receive credit for the work, provided the condition is removed within a reasonable time after the condition has been incurred.

A student may withdraw from a course in which he has registered during the first two weeks with the consent of the instructor, registrar, and president. After this time he may withdraw only with the consent of the faculty. All withdrawals must be formal and must be recorded by the student with the registrar, otherwise the student will be credited with a failure in that subject.

EMPLOYMENT AND AID FOR STUDENTS

A large number of students of the School of Mines earn either the whole or a part of their expenses while in college. The School cannot guarantee work for students, but under ordinary conditions of mining most of the students find work in the mines for two shifts a week. A few students find work about the school as stenographers and laboratory assistants. During the summer vacations students readily find profitable employment in many occupations, but especially in mining.

MILITARY SERVICE SCHOLARSHIPS

Upon the proper certification of the president that a student has rendered military or naval service to the nation and has been honorably discharged, the Chancellor of the University of Montana will authorize the award of a Military Service Scholarship to such student. The holders of such scholarships, throughout the course, will be exempt from the payment of all regular fees, but not laboratory deposits or special course tuitions.

By special action of the State Board of Education the privileges of the Military Service Scholarship are extended to all students of the University of Montana who met the requirements for membership in the Students' Army Training Corps, and to all who actually took up work in one of the corps of the University of Montana, but were deprived of induction through the action of the War Department cancelling all inductions which were not complete November 11, 1918.

GENERAL UNIVERSITY STUDENT LOAN FUNDS

The Montana Bankers' Association, and the Alumni of the University of Nebraska residing in Montana, have each established loan funds, which are available for students in the junior and senior classes of any of the institutions of the University of Montana who are unable to continue their studies without financial aid and are satisfactorily recommended as to character and scholarship by the dean or director or the head of the department in which the applicant's major work is done. The loan to any one student is limited to two hundred dollars during his course, but not more than one hundred dollars in any one year. Loan must be repaid within one year from the time of borrowing, or, in exceptional cases, one year after graduation. Loans bear two per cent. interest.

AUXILIARY WORK

BUREAU OF MINES AND METALLURGY

The Legislative Assembly of Montana for 1919 (Chapter 161, Page 311), established in the State School of Mines a State Bureau of Mines and Metallurgy. A fund of $20,000.00, necessary for the maintenance of the Bureau, was appropriated for the biennium ending Feb. 28, 1921.

The bureau is organized into four major departments, Administration, Geology, Mining and Metallurgy, and Safety.

The object and duties of the bureau, as specified by law, are as follows:

1. To collect, to compile, and to publish statistics, relative to Montana geology, mining, milling and metallurgy.

2. To collect typical geological and mineral specimens and samples of products; to collect photographs, models, and drawings of appliances used in mines, mills, and smelters of Montana.

3. To collect a library and a bigliography of literature pertaining to or useful for the progress of geology, mining, milling and smelting in Montana.

4. To study the geological formations of the State with special reference to their economic mineral resources, both metallic and nonmetallic.

5. To examine the topography and physical features of the State with reference to their practical bearing upon the occupations of the people.

6. To study the mining, milling and smelting operations carried on in the State, with special reference to their improvement.

7. To prepare and to publish bulletins and reports, with necessary illustrations and maps, which shall embrace both a general and a detailed description of the natural resources and geology, mines, mills and reduction plants of the State.

8. To make qualitative examinations of rocks and mineral samples.

9. To consider such other scientific and economic problems as in the judgment of the State Board of Education are of value to the people of the State.

10. To communicate special information on Montana geology, mining and metallurgy.

11. To co-operate with the other departments of the University of Montana, with the State Mine Inspector, and with other departments of the State Government as may be mutually beneficial; and to co-operate

with the United States Geological Survey, and with the United States Bureau of Mines, in accordance with the regulations of those institutions.

The results of the work of the bureau are published in bulletins and circulars, which are distributed free of cost to those requesting them. The bureau has been established primarily for service, and so far as is reasonable all problems and questions relating to the mineral resources or mining and metallurgical industry of the State will receive careful consideration. All samples and letters should be addressed to the State Bureau of Mines and Metallurgy, Butte, Montana.

STUDENT ACTIVITIES

While it is impossible in an engineering school to maintain as wide a range of student activities outside of classroom instruction as is possible in colleges which specialize in other lines of work, yet it is recognized that these activities are, and should be, a part of the life of a normal student. As much encouragement is given them as is consistent with good work in the courses of study.

THE A. S. S. M.

The Associated Students of the School of Mines is a regularly organized association of which any student may be a member if he has paid the student activity fee. It has general supervision over all matters in which the students as a whole are interested. It also has the power to determine to what extent student government may apply in controlling traditions, general conduct, and the action to be taken when student rules are broken. General control of athletics, student publications, debating, and other activities which affect all the student body is in its hands.

ATHLETICS

As much encouragement is given to intercollegiate and interclass athletics as is possible in a school of this type. Teams were maintained last year in football and basketball, and schedules were played with Montana and other Northwestern colleges appearing on the list. The eligibility rules of the Pacific Northwest Intercollegiate Conference are in force. Competent coaching is secured for the various athletic teams. Within a short time it is hoped that the facilities of the school for athletics will be increased and that it may be possible to add track and baseball to the sports now maintained. In Butte there are several good gymnasiums which have swimming pools and handball courts. No student need lack for physical exercise and games in good surroundings if he desires them.

THE ANDERSON-CARLISLE TECHNICAL SOCIETY

The Anderson-Carlisle Technical Society is an organization to promote the discussion of mining and engineering topics and to develop good fellowship among the men in attendance. Smokers are held every few weeks, at which speak men of prominence in mining and engineering work who have subjects of practical interest to discuss. The Society is affiliated with the American Institute of Mining and Metallurgical Engineers as a Junior Branch.

THE DANCING CLUB

The Dancing Club has general supervision over all social affairs given by the student body, as a whole, or by the various classes. Under its guidance are held the Junior Prom, the Christmas Dance, and other social events of the school year.

MISCELLANEOUS ACTIVITIES

During the spring of 1922 the Senior class published "The M," a School of Mines Annual, reviving a custom allowed to lapse for a number of years. It is the purpose of succeeding classes to issue "The M" each year from now on.

In April, 1922, the School of Mines sent a representative to the Montana State Intercollegiate Oratorical Contest at Helena, the representative, Walker B. Carroll, 1922, winning second place. Membership in the Montana State Oratorical Association is to be maintained and oratory will be encouraged as a student activity.

JUNIOR AND SENIOR TRIPS

It has long been the custom for the Juniors and Seniors to take an inspection trip to Montana and other mining districts before work ends in the Spring. These trips are planned with the advice and approval of the faculty, and they are conducted under the direction of members of the faculty. It is required that the inspection work on these trips and the reports asked afterwards be satisfactory to the faculty members in charge before credit is given towards graduation.

Organization of Instruction

The State School of Mines offers courses leading to the degrees of Mining Engineer, and of Metallurgical Engineer, the latter conferred for the first time in 1922.

As now organized, the School consists of four major departments, mathematics and mechanics, metallurgy and chemistry, geology and mineralogy, and mining engineering. Mathematics and mechanics are required as fundamental for all forms of engineering, and the other three departments emphasize the three main branches of mining. In addition to the subjects offered in these major departments. classes are given in English composition, economics, physics, and Spanish.

COURSES IN MINING ENGINEERING

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	4	4
Trigonometry	4	4
General Chemistry:		
Lectures and Recitations	4	4
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	17

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	5
Plane Surveying	3	3
Qualitative Analysis:		
Lectures and Recitations	4	5
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester

	Exer. Hrs. of	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mech	4	4
Physics	4	3
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Mining	1	1
Mine Surveying, Theory	2	1
	29	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology	4	3
Principles of Metallurgy	2	1½
Metallurgy Laboratory	3	1
Fire Assaying	1	½
Mining:		
Lectures	2	3
Drawing	6	
Mine Surveying:		
Field Work	2-wk.	2
Mapping	3	
Mechanics	4	4
Physics Laboratory	6	2
	30	18

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology:		
Lectures	4	4
Laboratory	3	
Metallurgy of Copper	3	3
Assaying	6	2
Mining:		
Lectures	2	3
Laboratory	3	
Hydraulics	4	4
Graphics	3	1
	30	17

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
General Metallurgy:		
Lectures	3	6
Laboratory	9	
Mining	2	2
Ore Dressing:		
Lectures	2	4
Design	6	
Economic Geology	5	6
Field Geology	3 weeks	
Thermodynamics	3	2
	30	20

Second Semester

	Hrs. of Exer.	Units
General Metallurgy:		
Lectures	3	5
Laboratory	6	
Mining	3	3
Ore Dressing:		
Lectures	2	4
Design	6	
Mining Geology:		
Lectures	5	5
Field Work	3	
Power Transmission	2	2
	30	19

COURSES IN METALLURGICAL ENGINEERING

FRESHMAN YEAR

First Semester

	Hrs. of Exer.	Units
English Composition	3	2
Algebra	4	4
Trigonometry	4	4
General Chemistry:		
Lectures and Recitation	4	4
Laboratory	6	
Mechanical Drawing and Descriptive Geometry	9	3
	30	17

Second Semester

	Hrs. of Exer.	Units
English Composition	3	2
Analytical Geometry	5	5
Plane Surveying	3	3
Geology	3	2
Qualitative Analysis:		
Lectures and Recitation	4	5
Laboratory	9	
Mechanical Drawing and Descriptive Geometry	6	2
	30	17

SOPHOMORE YEAR

First Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus	4	4
Physics	5	4
Mineralogy:		
Lectures	2	2
Laboratory	3	
Quantitative Analysis:		
Lectures	2	3
Laboratory	6	
Topographic Drawing	6	2
Plane Surveying, Field Work	4-wk.	2
	30	19

Second Semester

	Hrs. of Exer.	Units
Engineering English	2	2
Calculus and Analytical Mechanics	4	4
Physics	4	3
Mineralogy and Petrology:		
Lectures	2	3
Laboratory	6	
Quantitative Analysis:		
Lectures	2	4
Laboratory	9	
Mining	1	1
	30	17

JUNIOR YEAR

First Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology	4	3
Principles of Metallurgy	2	1½
Metallurgy Laboratory	3	1
Fire Assaying	1	½
Physical Chemistry:		
Lectures	2	3
Laboratory	6	
Mechanics	4	4
Physics Laboratory	6	2
	30	17

Second Semester

	Hrs. of Exer.	Units
Engineering Economics	2	2
Geology:		
Lectures	4	2
Laboratory	3	
Metallurgy of Copper	3	3
Assaying	6	2
Electro Chemistry:		
Lectures	2	2
Laboratory	3	
Hydraulics	4	4
Graphics	3	1
	30	17

SENIOR YEAR

First Semester

	Hrs. of Exer.	Units
General Metallurgy:		
Lectures	3	6
Laboratory	9	
Ore Dressing:		
Lectures	2	4
Design	6	
Electro Metallurgy	3	3
Metallurgy Problems	3	3
Thermodynamics	3	2
	29	18

Second Semester

	Hrs. of Exer.	Units
General Metallurgy:		
Lectures	3	4
Laboratory	3	
Ore Dressing:		
Lectures	2	4
Design	6	
Physical Metallurgy:		
Lectures	3	4
Laboratory	3	
Metallurgy Problems	3	3
Power Transmission	2	2
	25	17

CHEMISTRY

PROFESSOR, L. J. HARTZELL. ASSOCIATE PROFESSOR, A. E. KOENIG

General Chemistry: One Semester. Fall. 4½ credits. Deposit, $15.00.* Freshmen. Two lectures, two recitations, and six hours of laboratory a week. The object of this course is to develop the underlying principles of the subject as a basis for all subsequent work in the department. The student is drilled on the laws governing chemical phenomena and is made familiar with the principal characteristics and relations of the elements. The work is illustrated by experiments conducted in the laboratory and during the lectures. Text: "Outlines of Chemistry," Kahlenberg. Mr. Koenig.

Qualitative Analysis: One Semester. Spring. 5½ credits. Deposit, $15.* Freshmen. Prerequisite, General Chemistry. Two lectures, two recitations, nine hours of laboratory a week. The student is instructed in the general scheme for the separation and detection of the metallic elements and the more common acid radicals. The general chemistry of the metals and their compounds is included in this course. Text: Prescott and Johnson, "Qualitative Analysis." Mr. Koenig.

Quantitative Analysis: Two Semesters. Continuous. 6 credits. Deposit, $15.00. Sophomores. Prerequisite, Qualitative Analysis. Lectures, recitations and laboratory. The course is designed to meet the needs of the Mining Engineer in the pursuit of his profession. It embraces all general methods of analysis as applied to limestones, dolomites, ores of iron, manganese, lead, zinc, copper, arsenic, antimony, tin and also the analysis of rocks, cements, slags, mattes and water analysis.

The subject of acidimetry and alkalimetry is taken up and the principles explained. Analysis of several acids and alkaline solutions are made to demonstrate the subject.

The object of this course is to develop the student's ability to perform his work rapidly and accurately. The problems and laboratory work are selected as far as possible from the work of the practitioner in the smelters and mines of the West.

While these practical features are employed, the instructor bears it ever in mind that the student must use his own talents and learn to think and reason for himself.

Two lectures and six hours laboratory throughout the year. Text: A. H. Low, "Technical Ore Analysis." Lecture Notes. Mr. Hartzell.

Physical Chemistry: One Semester. Fall. 3 credits. Deposit $10.00.* Juniors. Prerequisites: General Chemistry, Physics, Qualitative and Quantitative Analysis. Two lectures, and six hours of laboratory a week. The aim of this course is to give the student a chemical philosophy and a working knowledge of physico-chemical methods. The relations and applications of the phase rule, mass law, and different forms of energy to various chemical phenomena, are studied and illustrated by problems and laboratory work. Text: Getman, "Outlines of Theoretical Chemistry," Findlay, "Practical Physical Chemistry." Mr. Koenig.

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*NOTE: The $15.00 fee for General Chemistry includes the deposit for Qualitative Analysis when the latter is taken in direct continuation of the former.

Electro-Chemistry: One Semester. Spring. 2 credits. Deposit, \$10.00.* Juniors. Prerequisites: Same as for Physical Chemistry. Two lectures, and three hours of laboratory a week. This course is a study of the fundamental theories of electrolytic conductance, electrolysis and electromotive force in their relation to the electro chemical preparation of the elements and their compounds. The applications of these theories are illustrated by problems and laboratory measurements. Text: Getman, "Outlines of Theoretical Chemistry," supplemented by lecture notes and assigned reading; Findlay, "Practical Physical Chemistry"; and Watts, "Laboratory Course in Electro-Chemistry." Mr. Koenig.

ENGLISH AND ECONOMICS

PROFESSOR, W. T. SCOTT.

English Composition: Two semesters. Continuous. 4 credits. Freshmen. Lectures and recitations. The purpose of the course is to arouse the student to realize the importance of being able to use good English, and to teach him how to write and speak clearly, accurately, and easily, especially upon scientific and engineering topics. The course also aims to prepare for the ordinary use of English in business and to explain the principles which lie back of business usage. The first semester includes work in the fundamentals of composition, speaking, and parliamentary law. The second semester specializes on business English, but continues the work in speaking, emphasizing its use in business. Texts: "The Century Handbook of Writing," by Garland Greever and Easley S. Jones; "Handbook of Parliamentary Law," by F. M. Gregg; "The Business Man's English," by W. E. Bartholomew and Floyd Hurlbut. Mr. Scott.

Engineering English: Two semesters. Continuous. 4 credits. Sophomores. Oral and written exercises in describing and explaining mechanical devices, engineering processes, and scientific principles; followed by formal written reports such as are required of engineers; and completed by oral reports which must stand up under group criticism and questioning. Texts: "Technical Writing," by T. A. Rickard; "The Composition of Technical Papers," by Homer Andrew Watt. Mr. Scott.

Economics: Two semesters. Continuous. 4 credits. Juniors. Lectures and recitations. The first semester deals largely with the industrial history of Europe and the United States, a background being given for modern industrial conditions and modern economic thought. The second semester takes up the economic theories which lie back of modern industrial organization and shows how they apply to the engineering industry in general and to mining in particular. Text: "The Introduction to the Study of Economics," by Charles J. Bullock. Mr. Scott.

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*NOTE: The \$10.00 fee required for Physical Chemistry includes the deposit for Electro-Chemistry when the latter is taken in continuation of the former. Physical and Electro-Chemistry are not required in the Mining Engineering Course.

GEOLOGY AND MINERALOGY

PROFESSOR, E. B. YOUNG. ASSISTANT PROFESSOR, G. S. LAMBERT.

General Geology: 1 semester. Fall. Continuous. 4 credits. Juniors. Lectures, recitations, problems and field excursions. Physiographic, dynamic and structural geology are studied throughout the year. Several hundred lantern slides, maps and numerous models of various types are used. During the second semester solution of a series of fifty problems in structural geology are required. The needs of the mining engineer are kept constantly in mind and numerous illustrations are given showing where geologic principles may be applied to practical problems. Text: "Textbook of Geology," by Pirsson and Schuchert. Mr. Young.

Mineralogy: 2 semesters. Continuous. 2 credits fall semester, 3 credits spring semester. Sophomores. Deposit $10.00. Prerequisite, Qualitative Analysis. Lectures, recitations, laboratory, museum study and field excursions. The purpose of the course in mineralogy is to familiarize the student with about one hundred and fifty of the commoner minerals, especially those of economic importance. Accuracy and rapidity in determining minerals by means of physical and chemical tests, and by sight, is the object sought. The course is divided into crystallography, blow pipe analysis, and determinative and descriptive mineralogy. Text: "Dana's Manual of Mineralogy," by W. E. Ford. Mr. Lambert.

Structural Geology: 1 semester. Spring. 1 credit. Juniors. Lectures and recitations and field trips. Prerequisite, general geology. Advanced work in map interpretation is given, together with application of the principles of stratigraphy to mining problems. The theories and principles concerning the origin, migration and accumulation of petroleum and gas are briefly studied, and applied to the situation as found in Montana.

Geology of North America: 1 semester. Spring. 2 credits. Juniors. Lectures, recitations and laboratory. Prerequisite, general geology. An introduction of historical geology is followed by a study of the physiographic provinces of North America. The needs of the mining engineer are kept constantly in mind in the selection of material for assignments. The course closes with lectures on the geology of Montana.

Economic Geology: One semester. Fall. 4 credits. Seniors. Prerequisite. Geology and Mineralogy. Lectures and recitations. A course in the more theoretical aspects of the geology of ore deposits, including structural features, transportation and deposition of minerals, the alteration of wall rocks, classification of ore deposits, and secondary enrichment. A knowledge of the geographic distribution, geological features, and the commercial value of mineral deposits, both metallic and nonmetallic, especially those of North America, is gained by the preparation of reports and maps. Text: "Mineral Deposits," by W. Lindgren. Mr. Young.

Field Geology: Three weeks field work. 2 credits. Seniors. Prerequisite, Geology, Mineralogy, and Plane Surveying. A course in the various methods of geological surveys, including plane table, pacing traverse, and reconnaissance methods. Geological maps are not only prepared, but material for laboratory study is collected and geological reports are written. Mr. Young.

Mining Geology: One semester. Spring. 5 credits. Seniors. Prerequisite, Economic and Field Geology. Lectures, recitations, and field work. Application of geology of ore deposits to practical mining problems, and two weeks of field work in the principles and practice of underground geologic mapping, with the preparation of geological reports on the mines examined. Mr. Young.

MATHEMATICS AND MECHANICS

PROFESSOR G. W. CRAVEN. ASSOCIATE PROFESSOR, A. E. ADAMI.
ASSISTANT PROFESSOR, E. RALPH BOWERSOX.
INSTRUCTOR, C. M. BLACKBURN.

Algebra: One semester. Fall. 4 credits. Freshmen. Lectures and recitations. After a preliminary course, designed to drill the student in the fundamental algebraic operations, and in the statement and solution of problems, those operations of advanced algebra, which will be of use to the student in future engineering courses, are carefully studied. Special attention is given to the theory and use of exponents, simultaneous quadratic equations, equations solved as quadratic, variation, series, complex quantities, and undetermined coefficients. Text: "College Algebra," by Wentworth. Mr. Bowersox and Mr. Blackburn.

Trigonometry: One semester. Fall. 4 credits. Freshmen. Lectures and recitations. In plane trigonometry the subjects of primary importance are goniometry, solutions of right and oblique triangles, and practical problems. Those considered in spherical trigonometry are the solution of right and oblique spherical triangles, and their devleopment and practical application to surveying and measurement. Text: "Plane and Spherical Trigonometry," by Wentworth. Mr. Adami.

Analytic Geometry: One semester. Spring. 5 credits. Freshmen. Prerequisites, Algebra, Trigonometry. Lectures and recitations. This course is designed to give the student such a working knowledge of the methods of mathematical analysis as will be necessary in his future engineering work. The student is required to solve analytically and plot the loci of numerous problems covering such topics as the point and straight line in the plane, different systems of co-ordinates, conic sections, higher plane curves, transcendental and parametric equations. Text: "Analytic Geometry," by Riggs. Mr. Bowersox and Mr. Blackburn.

Calculus: One semester. Fall. 4 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures and recitations. Differential and integral calculus covering the following subjects: Differentiations, tangents, normals, subtangents, subnormals, asympotes, indeterminate forms, logarithms, maxima and minima, curve tracing, integration, rectification of curves, areas, volumes, center of mass, moment of inertia, and work. Text: "Differential and Integral Calculus," by Taylor. Mr. Craven.

Calculus and Analytical Mechanics: One semester. Spring. 4 credits. Sophomores. Prerequisite, Calculus. Lectures and recitations. A continuation of the course in Calculus, and a consideration of the theoretical principles of mechanics. Text: "Differential and Integral Calculus," by Taylor. Mr. Craven.

Mechanics: 1 semester. Fall. 4 credits. Juniors. Prerequisite, Calculus and Analytical Mechanics. Lectures and recitations. In the course are considered the strength of materials, the laws of elasticity and resiliency, impact, fatigue, and the theory of beams and columns or struts. The course also includes a study of the properties of various building materials—the metals, timber, stone, brick, and cement.

It is the object of this course to direct the attention of the student to the elements of machinery design. It is necessary to devote considerable time to the study of simple mechanisms, such as screws, nuts, bolts, keys, pipes and pipe fittings, shafting, couplings, cylinders, and structural steel design. A study is also made of gearing, outlines of gear teeth, cams, linkwork, belts, and ropes. Special attention is given to the installtion and maintenance of machinery, and in this connection a great deal of practical information is gained by frequent visits to the repair shops of the Butte mines. Text: "Mechanics of Materials," by Merriman. Mr. Craven.

Mechanics and Hydraulics: One semester. Spring. 4 credits. Juniors. Prerequisite, Mechanics. Lectures and recitations. Follownig the conclusion of the course in mechanics, the course in hydraulics is introduced with a study of hydrostatics and theoretical hydraulics. A systematic study is then made of the problems involving the flow of water through orifices, over weirs, through flumes and conduits. Attention is given to the design of dams and their adjuncts and to the investigation of the various water wheels, and governing devices. Text: "Treatise on Hydraulics," by Merriman. Mr. Craven.

Physics: Two semesters. Continuous. 7 credits. Sophomores. Prerequisite, Analytical Geometry. Lectures, recitations, and laboratory. The topics considered are: Concurrent and parallel forces; center of gravity; inertia and rotation; friction and work; simple machines; mechanics of fluids; nature and measurement of heat and its application to the steam engine, and to the transmission of energy by means of compressed air; electricity and magnetism; a brief study of light and sound, including a study of optical instruments and of the phenomena met in the study of mineralogy and petrography; and the application of electricity to dynamos, motors, transmission of energy, and lighting. Text: "College Physics," by Kimball. Mr. Bowersox.

Thermodynamics: One semester. Fall. 2 credits. Seniors. Prerequisites, Physics and Calculus. Lectures, recitations and excursions. Following a short course in thermodynamics, a systematic study is made of the mechanism of engines, simple, condensing, and multiple expansion, foundations, bed plates, steamboilers and their adjuncts, and their setting and management, design and construction of chimneys, and general plans for power houses. Text: "Steam Engines and Boilers," by J. H. Kinealy.

In addition, a series of descriptive lectures of pumps and pump details, and the construction and management of mining pumps, is given. Text: "Pumping Machinery" by W. M. Barr. Mr. Craven.

Power Transmission: One semester. Spring. 2 credits. Seniors. Prerequisite, Physics and Mechanics. Lectures, recitations and excursions. The student's attention is directed to the general conditions of power transmission, synchronous and induction motors, current reorganizers, hydraulic development, organization of a power station, line construction, centers of distribution, commercial problems, and measurement of electrical energy. The numerous electrical plants about Butte offer opportunities for observing most excellent practice in this field. Text: "Power Transmission," by Bell. Mr. Craven.

Mechanical Drawing and Descriptive Geometry: Two semesters. Continuous. 5 credits. Freshmen. Lectures and drawing room. The primary object of instruction in mechanical drawing is to lay the foundation for the skill, neatness, and speed necessary to pursue the subsequent courses. Students are required to complete a given number of plates, drawing the projections, sections, and intersections of simple objects which are merely described to them. It is the aim to guard against the copying of drawings, so that the student learns to think and construct for himself. The course includes practice in freehand lettering, and the student is taught the use of water-color as applied to engineering drawing. Practice is also given in coloring maps and shading parts of machine drawing. As far as possible the problems in drawings are taken from those met by the engineer in practice. The study of descriptive geometry is completed and applied to engineering design. Texts: "Mechanical Drawing" and "Descriptive Geometry," by L. Faunce. Mr. Craven, Mr. Bowersox, and Mr. Blackburn.

Graphics: One semester. Spring. Juniors. 1 credit. Prerequisites, Mechanical Drawing and Descriptive Geometry. Lectures, recitations, and drawing. The course in graphics is intended to familiarize the student with graphical methods of obtaining the stresses in the members of any of the common structures intended to support a load above an opening—a roof, bridge, or truss. A detailed study is made of the proportions of the various standard roof trusses, attention being given to loads due to materials, wind, and snow. Text: "Steel Mill Buildings," by Ketchum. Mr. Craven.

METALLURGY

PROFESSOR, H. T. MANN. INSTRUCTOR, C. L. WILSON.

Principles of Metallurgy: One semester. Fall. Juniors. 1½ credits. Prerequisites: Quantitative Analysis and Physics. Lectures, recitations, plant inspections, and reports. The course is an introduction to the study of metallurgy. The nature of the metals is considered, with outlines of the principles and practices for the winning of all the common metals. The metallurgical industries have their nature and importance presented, after which those operations and processes common to several metals are studied. Students are taken to local plants, have the work explained, and are then required to prepare suitable reports. Mr. Mann.

Metallurgy Laboratory: One semester. 1 credit. Juniors in Metallurgical Engineering. Prerequisite, to be accompanied by Principles of Metallurgy. This course is intended for men who wish a degree in metallurgical engineering. It will take up in detail Pyrometry, Refractories, Fuel Testing, Gas Analysis, the Physical Properties of Metals, Cooling Curves, Roasting, Study of Slags, Use of the Microscope in Metallurgy, and Ore Dressing and Heat Conduction. Mr. Wilson.

Metallurgy of Copper: One semester. 2 credits. Juniors, Prerequisite, Principles of Metallurgy. The metallurgy of copper is considered along the following lines: The properties and uses of copper, its compounds, and its alloys; the markets for copper and its ores and the principles underlying their sale and price; the ores of copper; the smelting of roasted and oxidized ores of copper to black copper, touched on briefly; the roasting of copper ores as a preliminary to smelting; the handling of the smoke from copper furnaces to save the values contained therein and to remove from these gases their injurious constituents; the smelting of roasted ores to matte in the reverberatory furnace; the smelting of ore to matte in the blast furnace, either with or without the attempt to volatilize a considerable portion of the sulphur; the smelting of raw massive sulphides to matte in the blast furnace, or pyrite smelting; the converting of copper matte to blister copper in the basic and in the acid converter; the furnace refining of copper; the production of copper from matte by the various roast-reaction of roast smelting methods; the electrolytic refining of copper; and hydrometallurgy of copper. Mr. Mann.

General Metallurgy: One semester. Fall. 3 credits. Seniors. Prerequisites, Principles of Metallurgy and Fire Assaying. This course includes a study of the metallurgy of lead, and gold and silver.

Metallurgy of Lead: The course in the metallurgy of lead includes work along the following general lines: The properties and uses of lead, its alloys, and compounds; the ores of lead and the methods and principles of their sale; the principles and practice of sampling the ores and their products; the general principles used in the winning of lead from its ores; the treatment of lead ores in the reverberatory smelting furnace; the winning of lead from its ores by smelting in the ore hearth, or Scotch hearth, considerable attention being paid to this method on account of its importance with the ores of the Mississippi Valley; the roasting of lead ores and the strides that have recently been made in this important preliminary to the lead blast furnace; the winning of ores in the lead blast furnace; (this heading is, of course, an important one in the subject, and under it are taken up the blast-furnace plant, the chemistry of the blast furnace, the calculation of furnace charges, the calculation of the costs of smelting, and the handling of products, particularly the smoke or fume); the desilveration of base bullion by means of the Parkes, Pattison, and cupellation processes, as well as by the Betts process. Throughout this course, as well as the other courses of this department, the work is accompanied by problems which bring out the ideas which the classroom work considers.

Metallurgy of Gold and Silver: The study of the metallurgy of gold includes lectures and recitations along the following general lines: The properties of gold, gold alloys, and the compounds of gold; the chlorination and bromination of gold ores, considered more in the light of historic value of these processes than for their present importance as schemes of gold extraction; the amalgamation methods of silver and gold ores are taken up in detail in the course on ore dressing. The study of the metallurgy of silver is considered as suggested by the following topics: The properties of silver, of its alloys, and of its compounds; the winning of silver from its ores by the various leaching schemes that were formerly of greater importance than at present, schemes which include the Augustin process, the Ziervogel or Argo process, and the various methods of hyposulphite leaching, each considered only briefly. The greater part of the time of the course in gold and silver is devoted to the study of the cyanide process, which is considered in detail. The parting of gold and silver by the various acid and electrolytic schemes and the winning of gold and silver from their ores by the various smelting schemes are considered under the head of metallurgy of lead and copper. Mr. Mann.

General Metallurgy: One semester. Spring. 3 credits. Seniors. Prerequisites, Metallurgy of Copper and Lead, and Fire Assaying. This course includes a study of the metallurgy of zinc, iron and steel, tin, antimony, and aluminum.

The metallurgy of zinc is considered under the following headings: The properties and uses of zinc, its alloys and compounds; the ores of zinc and the methods and the principles underlying their sale; the roasting of zinc ores, with a brief study of the use of zinc ores as a source of sulphuric acid; the distillation of zinc ores and the furnaces suited for this purpose; the factors on which the success of the distillation depends; the manufacture of retorts and condensers; the laws of condensation of vapors to liquids and their application to the condensation of zinc vapors; the products of zinc smelting, and the methods of handling and treating these products; the cost of smelting zinc ores figured on the basis of a number of typical ores; the refining of spelter; the markets for spelter and the various brands of spelter; special schemes other than the ordinary methods that have been used or proposed for use in the winning of zinc from its ores; the electric smelting of zinc ores; the hydro-metallurgy of zinc; the manufacture of zinc oxide pigment. Throughout this course problems are given to illustrate the ideas set forth in the class.

The metallurgy of iron and steel takes up the following topics: The use of ferrous materials; the production and properties of pigment, cast-iron, wrought-iron, and the various kinds of steel; the making of ingots; the mechanical and heat-treatment of steel; and the correlation of structure and properties to intended use. The class also studies and reports upon several local foundries. Mr. Mann.

General Metallurgy Laboratory: First semester. 3 credits. Deposit, $15.00. Seniors. Three afternoons per week. Prerequisites, Principles of Metallurgy. Assaying. This course aims to show the practical application of the principles outlined in the course in general metallurgy. Mr. Mann.

General Metallurgy Laboratory: Second semester. 1 credit. Deposit, $15.00. Seniors. Two afternoons per week for 9 weeks. Prerequisites, First Semester General Metallurgy. This course is a continuation of the work from the first semester. Mr. Mann.

Fire Assaying: One semester. ½ credit. Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Lectures and recitations. This course deals with the theory of fire assaying as practiced in the laboratory. Mr. Wilson.

Fire Assaying: One semester. 1 credit. Junoirs. Prerequisites, Juniors. Prerequisite, Quantitative Analysis and Mineralogy. Laboratory course. The study of assaying is approached from both the theoretical and practical sides. The course is intended to increase the proficiency of the student in thinking, in knowledge, and in manipulative skill. A great variety of ores, furnace products, and metals are worked upon in the laboratory by the best methods. Text: "The Sampling and Assay of the Precious Metals," by Smith. Mr. Wilson.

Electro-Metallurgy: One semester. Fall. 3 credits. Seniors in metallurgical engineering. Prerequisite, Electro-Chemistry and Principles of Metallurgy. Lectures and recitations. Lectures are given covering the electro-metallurgical processes that are in use. Efficiency and engineering calculations based on these processes are also given. Mr. Mann.

Metallurgy Problems: Two semesters. Continuous. 6 credits. Seniors in metallurgical engineering. Prerequisites, Principles of Metallurgy, the Metallurgy of Copper. Lectures and recitations. This course aims to cover the common problems that the metallurgist meets in practice. Mr. Wilson.

Physical Metallurgy: One semester. Spring. 4 credits. Seniors in metallurgical engineering. Prerequisite, Metallurgy of Lead. Lectures, recitations, and laboratory. This course deals with the theoretical and practical considerations that influence the structure and properties of alloys of different types. Mr. Mann.

MINING ENGINEERING AND SURVEYING

PROFESSOR, THEODORE SIMONS.

ASSOCIATE PROFESSOR, A. E. ADAMI.

Plane Surveying: One semester. Spring. 3 credits. Freshmen. Prerequisites, Algebra and Trigonometry. Lectures and recitations. The course in the theory of plane surveying takes up the construction, adjustment, use, and care of surveying instruments, the form of field notes for different methods of surveying, computation of bearings, co-ordinates, elevations, areas, and quantities of material, from data secured in the field, the solution of problems in surveying, and practical uses of surveying instruments on the school grounds. Text: "Plane Surveying," by Tracy. Mr. Adami.

Plane Surveying, Field Work: Summer Field Work, 4 weeks. 2 credits. Deposit, $10.00. Sophomores. Prerequisite, Plane Surveying. During the course in plane surveying the students are required to execute the following surveys and prepare the necessary field notes, maps, profiles, and calculation sheets; determination of true meridian by solar observation and by observation on Polaris; traverse survey with transit and steel tape; angles by repetition; azimuth and deflection; problems in public land surveying in accordance with Manual Instructions to United States Deputy Surveyors; official survey of mining claims and application for United States patent; returns to consist of letters of transmittal, plat, field notes, and computations, in form of transmission to United States Surveyor General; topographic survey with transit and steel tape; stadia and trigonometric survey; base line triangulation; leveling for profile and contour lines, and for establishment of bench marks; staking out buildings and excavations for foundations, and calculations of quantities to be excavated; survey of ditch or flume line; preliminary and location survey of railroad. Mr. Adami.

Topographic Drawing: One semester. Fall. 2 credits. Sophomores. Prerequisites, Plane Surveying, Field Work. The work consists of platting on a suitable scale the surveys executed in the field. During the preparation of the various topographical sheets, the students are instructed in the use of conventional signs for surface representations, including additional conventions required by the mining engineer, such as those for geological outcrops, stratification, mineral veins, shafts, tunnels, mine dumps and mills. Additional instruction is given in the construction of contour lines and in the laying out of railroads and wagon roads, dams, reservoirs, flumes, and ditches on contour maps, and in calculating the quantities of cut and fill, the capacity of reservoirs, by cross sections made from contour maps. During the work special attention is given to lettering, titles, borders, and north points, and general neatness in execution. Mr. Adami.

Mine Surveying Theory: One semester. Spring. 1 credit. Sophomores. Prerequisites, Plane Surveying, Topographical Drawing, Algebra, Trigonometry, and Descriptive and Analytical Geometry. A course of lectures on underground surveying and shaft plumbing, including the mathematical and graphical solution of numerous surveying problems. Mr. Simons.

Mine Surveying, Field Work, and Mapping: Summer Field Work, 2 weeks. One semester. Fall. 2 credits. Deposit, $10.00. Juniors. Prerequisite, Mine Surveying Theory. During the course in Mine Surveying, carried on at a mine in actual operation, the student is required to execute the following surveys and prepare the necessary field notes: Plumbing the shaft; a survey of underground workings, as well as important surface features, such as buildings, ore bins, tracks, claim boundaries, and streets. In the class-room all necessary calculations are made for the final platting of the field notes on a composite map showing the underground workings, surface plant, claim lines, and city streets. In addition, a number of sections are made indicating the position of the ore bodies, shafts, levels, cross-cuts, and stopes, in their proper relation. Mr. Simons.

Mining: Two semesters. Continuous. 6 credits. Juniors. Prerequisite, Mine Surveying Theory. Lectures, drawing, and laboratory. The course in mining takes up the following topics: prospecting, discovery, locating and acquiring title to mining claims, breaking ground by various methods of hand work, rotary and percussion drills, explosives and their uses, supporting excavations by timbering, masonry, and metallic supports. The lectures and recitations are illustrated by drawings, prints, models, and frequent visits to the local mines. While at the mines special attention is given to the uses and handling of explosives, methods of timbering, stoping, diamond drills, and boring by percussion drills. In the laboratory actual tests on various kinds of drills are given, with a view to determine the air consumption, rate of drilling, efficiency, and cost of operation. In the drawing room the students are taught to make drawings of structures in wood, masonry, and metal, including ore and coal bins, railroad trestles, headframes, and various buildings found at a mine, such as boiler, compressor, and warehouses, hoist house, and general offices. The problems, with all conditions and requirements, are dictated to the students, and numerous blue prints of actual constructions are on file for reference. Mr. Adami.

Mining: Two semesters. Continuous. 5 credits. Seniors. Prerequisites, Junion Mining, All Mathematics, Physics, Mechanics, and Hydraulics. Lectures and design. A course in air compression. Prospecting for placer deposits, exploitation of gold placers by hydraulicking, dredging, water supply for these operations, reservoirs, dams, ditches, and pipe lines. Exploitation of useful minerals by open work and various methods of underground stoping. Mine haulage, hoisting, and hoisting machinery and accessories. Drainage and pumping, ventilation, natural and artificial, light and sanitary arrangements, commercial mining operations, superintendency and management of mines, selecting and buying samples and machinery, mine economics and mine accounts, examination and reporting on mines and mining enterprises. Mr. Simons.

Ore Dressing: Two semesters. Continuous. 8 credits. Prerequisite, Junior Metallurgy, all Mathematics, Physics, Mechanics, and Hydraulics and Calculus. Lectures, design, and laboratory. A study of the physical laws governing the various processes of ore dressing, such as crushing, jigging, free and hindered settling, the principles of screen sizing and hydraulic classification, the construction and operation of typical milling machinery, breakers, rolls, grinding mills, jig tables, vanners, magnetic separators, flotation processes, mill accessories, power transmission and water supply for milling operations. The methods of ore dressing are further studied at plants visited during the school year, and by practical tests in the ore-dressing department of the school laboratory. The course leads to the design of a complete plant for one or more operations of mining and ore dressing. In this the student is required to make use of catalogs and reference books to obtain the data necessary for the completion of his problem. Attention is given to the assembling, bills of materials, and the item of costs.

The course in mining and ore-dressing is completed by a two weeks' visit to districts where mining and ore-dressing methods differing from those prevailing in the Butte district may be studied. Mr. Simons.

SPANISH

INSTRUCTOR, B. F. THOMAS

Elementary Spanish: Two semesters. Continuous. Open to all students. Texts: "Spanish Grammar," by Espinosah and Allen, and "Lecturas Facilies," by Wilkons. Mr. Thomas.

REGISTER OF STUDENTS

SENIORS

Adelstein, Benjamin	Butte
Allen, Claude	St. Dennis, Cornwall, England
Bigelow, Frank O.	Butte
Bishop, Lester F.	Butte
Brockway, A. Grove	Spokane, Wash.
Carroll, Walker B.	Butte
Dougherty, James J.	Anaconda
Driscoll, Timothy, Jr.	Butte
Freshman, Walter C.	Butte
Frink, Ellis P.	Portland, Ore.
Groom, Carl M.	Butte
Kirwan, Gerald M., Jr.	Contact
Landwehr, Walter R.	Cottage Grove, Ore.
MacLellan, Donald D.	Butte
McDonald, Alex M.	Butte
McGonigle, Walter L.	Butte
Mowbray, Willard W.	Butte
Naughten, James J.	Butte
Nuckols, John A.	Anaconda
Scarlett, William A.	Lynn, Mass.
Shea, Edward P.	Butte
Stanaway, Ray C.	Butte
Symons, Henry H.	Butte
Walde, Leonard O.	Superior, Wis.

JUNIORS

Baker, Thomas D.	Butte
Borel, Arnold E.	Eldred, Pa.
Harmon, Charles H.	Grass Range
Harrington, Leonard T.	Butte
Healy, Aloysius	Butte
Gay, Ingles M.	Butte
Judge, Joseph A.	Butte
Ladic, Sanford W.	Butte
Lee, Wallis H.	Glendive
McMaster, P. D.	Butte
McNeil, Charles L.	Anaconda
McQuay, Ray	Butte
MacDonald, George D.	Butte
Moran, Aloysius	Butte
Murphy, William	Butte
O'Brien, Wallace	Butte
Osterholm, Victor L.	Grace

Price, William E.	Butte
Quinn, Hugh M.	Butte
Sahinen, George F.	Butte
Schwanz, Fred D.	Butte
Streibich, Fred William	Butte
Struthers, William A.	Big Timber
Thompson, A. J.	Butte
Thompson, Lawrence L.	Tilton, N. H.
Willson, Fay G.	Virgelle
Worcester, S. A., Jr.	Butte

SOPHOMORES

Caldwell, W. Elmer	Butte
Crowley, Dan E.	Butte
Dunstan, James	Butte
Gallagher, Peter B.	Butte
Guilio, S. J.	Corbin
Gussenhoven, Lloyd L.	Havre
Havey, Eugene F.	Butte
Hunter, Robert G.	Anaconda
Hurley, T. Stephen	Butte
James, John W.	Anaconda
Johnson, Albion	Great Falls
McGonigle, Charles J.	Butte
Maury, Jesse L.	Butte
Nutting, Haven C	Thompson Falls
O'Leary, Stephen J.	Butte
Quinn, John P.	Butte
Ryan, Dennis V.	Butte
Schmidt, Joseph K.	Anaconda
Shafer, Clarence	Sunnyside, Wash.
Sprake, Tyler W.	Mandan, S. D.
Steadman, John F.	Butte
Tait, Thomas W.	Howard
Toole, Robert H.	Butte
Walsh, Michael R.	Butte
White, James L.	Butte

FRESHMEN

Aronowsky, Dan	Butte
Arthur, Kathryn H.	Butte
Barrett, William	Butte
Benson, Vern R.	Butte
Bertoglio, John D.	Butte
Bettschen, George F.	Butte
Blomgren, Ruth V.	Butte
Canning, Mathew F., Jr.	Butte
Chancellor, W. Edloe	Butte

Charles, C. D.	Butte
Charteris, William C.	Great Falls
Chidester, Dolores E.	Butte
Choquette, A. Philip	Butte
Clark, Arthur M.	Rockville, Indiana
Eaton, Stuart	Butte
Ellis, Mina M.	Butte
Erickson, Martin E.	Butte
Evans, Emerson H.	Butte
Fell, William W.	Cody, Wyo.
Ferrando, Aldo	Butte
Gillis, John W.	Butte
Hackett, Joseph	Victor
Harrington, Mary C.	Butte
Hartzell, Lester J., Jr.	Butte
Hay, Lorne S.	Armington
Holland, Edw. J.	Butte
Johnson, Robert	Butte
Keppler, Anthony E.	Butte
Klein, Earl B.	Stepek
Knowlton, Benjamin E.	Butte
Lynch, Howard P.	Butte
McCafferty, Howard T.	Butte
McCormick, Walter N.	Butte
McGuire, John H.	Anaconda
Marick, Louis	Butte
Murray, Burnham H.	Chester
Myers, Walter H.	Los Angeles, Cal.
Naughten, Frank J.	Butte
Price, John D.	Butte
Rogers, James A.	Butte
Salomonson, Adolf	Anaconda
Shields, John F.	Butte
Stenson, John F.	Butte
Sullivan, Cornelius	Butte
Swanson, Leonard	Anaconda
Tallon, Geraldine	Butte
Templeton, A. Russell	Anaconda
Truzzalino, John H.	Butte
Wagner, Elton F.	Butte
Walker, Godfrey B.	Butte
Weyerstall, H. Frank	Butte

SPECIALS AND UNCLASSIFIED

Aronowsky, Celia	Butte
Bowlby, Robert H.	Butte
Brandt, Carl E.	Minneapolis, Minn.
Brome, Alice	Butte

Brown, George R.	Butte
Coady, Mrs. Fern	Butte
Cody, Mary E.	Butte
Crangle, Isabel	Butte
Crangle, Mary	Butte
Cumings, Sherman	Butte
Dingman, Oscar	Butte
Driscoll, Joanna	Butte
Ericsson, Ida	Butte
Everett, Charles V.	Butte
Griswold, George G., Jr.	Butte
Hogan, Maybelle	Butte
Humphreys, Lida	Butte
Keith, Allie	Butte
Kelley, Agatha	Butte
Kirchner, Oswald J.	Butte
Leonard, Minnie	Butte
Lutey, J. Kent	Kent
McGreal, C. C.	Butte
McManis, Sarah	Butte
Macdonald, Hughie Catherine	Butte
Madden, Ada F.	Butte
Makinson, Roy G.	Butte
Mann, Mrs. Besse C.	Butte
Mathews, Charles S.	Butte
Maury, George R.	Butte
Melzner, Mrs. Ida M.	Butte
Range, Ruth M.	Butte
Shaw, Frank L.	Butte
Wheeler, Mrs. Lulu	Butte
Wilcox, Frank O.	Butte

SUMMARY OF REGISTRATION

Seniors	24
Juniors	27
Sophomores	25
Freshmen	51
Specials and Unclassified	35
TOTAL	163

REGISTER OF ALUMNI

Adami Arthur E., 1907 .... Butte, Montana

Associate Professor of Mining Engineering, Montana State School of Mines, Mining Engineer, Montana State Bureau of Mines.

Aline, Peter A., 1915 .... Great Falls, Montana

Chemist, A. C. M. Co.

Amberson, Julius M., 1921 .... Chicago, Illinois

Graduate Student University of Chicago.

Andrew, John T., 1912 .... Butte, Montana

Lawyer.

Archibald, George B., 1905 .... Portland, Oregon

Carey Act Inspector, General Land Office, Dept. of the Interior.

Balmforth, Alfred J., 1904 .... Warren, Arizona

Efficiency Engineer Calumet & Arizona Mining Company.

Bassett, Arthur F., 1912 .... Detroit, Michigan

Detroit District Manager, Hyatt Roller Bearing Co.

Bender, Louis V., 1903 .... Anaconda, Montana

General Superintendent Washoe Reduction Works, A. C. M. Co.

Bovett, C. A., 1907 .... Verdi, Nevada

Bowden, Malcolm, 1908 .... Butte, Montana

Assistant Foreman Elm Orlu Mining Co.

Brinton, Owen F., 1905 .... Basin, Montana

Manager Jib Mining Company.

Brulo, William, 1909 .... Helena, Montana

Supt. Investment Department, Montana Life Insurance Co.

Cannon, Frank D., 1917 .... Butte, Montana

Safety Inspector, Berkley Mine, A. C. M. Co.

Carlisle, Stanley B., 1917.

Deceased.

Cheung, T. C., 1917.

Christian, Otto B., 1912 .... Los Angeles, Cal.

Cliff, Frank M., 1920 .... Tacoma, Washington

Asst. Manager Woolworth Store, Tacoma.

Clinch, R. S., 1911 .... Nacozari, Sonora, Mexico

Ore Buying and General Engineering.

Clinch, Walter D., 1912 .... Butte, Montana

Shift Foreman, Timber Butte Milling Co.

Cohan, Jesse E., 1912 .... Butte, Montana

Engineering Department, A. C. M. Co.

Cole, Robert J., 1914 .... Butte, Montana

Geologist, W. A. Clark, Jr.

Collins, Thomas F., 1917 .... Catorce, S. L. P., Mexico

Chief Engineer, Geologist, Refugio & Dolores Mines.

Cooke, Hamilton, Jr., 1912 .... St. Louis, Missouri

Agency Organizer, New York Life Insurance Co.

Corey, Clarence R., 1905..........Seattle, Washington
Assistant Professor Metallurgy, University of Washington.
Courtney, Edward F., 1919..........Butte, Montana
Mining Engineer, A. C. M. Co.
Crittenden, Zar T., 1913..........Pontiac, Michigan
Asst. Metallurgist, Oakland Motor Car Co.
Cullity, Emmet R., 1912..........Butte, Montana
Mining Engineer, Butte & Superior Mining Co.
Curran, Francis R., 1916..........Butte, Montana
Sampler Elm Orlu Mining Company.

Dobson, Chris G., 1913..........Seattle, Washington
Instructor College of Enginering, University of Washington.
Dugan, John F., 1906..........Butte, Montana
Foreman Nettie Mine, A. C. M. Co.
Duling, John F., 1904..........Los Angeles, Cal.
Member firm of Bennett & Duling, Engineers.
Duthie, John F., 1905.

Elford, Basil E., 1905..........San Francisco, Cal.
Ellis, Willis H., 1908..........Bozeman, Montana
Resident Engineer, State Highway Commission.
Engel, A. L., 1919..........Sewell, via Rancagua, Chile, S. A.
Milling Engineer, Braden Copper Company.
Evans, James R., 1909..........Tshikapa. Congo Belge, West Africa
Mining Engineer with Societe Internationale Forestiere et Minere du Congo.

Feeney, Charles M.
Deceased.
Foote, Frank A., 1908..........Dundu, Angola, via Tshikapa, Congo Belge, West Africa.
Mining Engineer.
Fowler, George M., 1912..........Salt Lake City, Utah
Geologist International Smelting Co., Salt Lake. Manager West Dome Oil Co., P. O. Box 313, Butte, Montana.
Fredell, Clarence A., 1921..........Missoula, Montana
Instructor Mineralogy, State University.
Freshman, Herman A., 1917..........Butte, Montana

Gaethke, Fred P., 1917..........Butte, Montana
Safety Engineer, Belmont Mine, A. C. M. Co.
Gidel, Murl H., 1912..........Butte, Montana
Geologist, A. C. M. Co.
Gieser, Herbert S., 1906..........Coolidge, Montana
Mill Superintendent, Boston & Montana Milling & Power Co.
Gilham, Ralph, 1909..........Butte, Montana
Internal Revenue Office.
Giovanetti, Ettore, 1912..........Butte, Montana
Instructor Butte Business College.
Goodell, Luther T., 1915..........Seattle, Washington
Pressman, Times Publishing Co.

Grunert, August, 1910 .... Butte, Montana
Chemist, Butte & Superior Mining Co.
Grupe, Charles W., 1912.

Haines, Peter A., 1909 .... Rivermines, Missouri
General Division Superintendent St. Joseph Lead Co.
Hale, Emmet, 1920 .... Butte, Montana
Safety Engineer, Original Mine, A. C. M. Co.
Hanson, Wilbur W., 1913 .... Washington, D. C.
Valuation Engineer, Natural Resources, Income Tax Unit.
Hill, William J., 1916 .... Santa Barbara, Chihuahua, Mexico
Foreman San Diego Group of Mines.
Hogan, Eugene, 1916 .... Butte, Montana
Asst. Foreman Emma Mine, A. C. M. Co.
Hunt, John E., 1915 .... Victor, Montana
Superintendent Curlew Mining Co.

Irelan, Arthur L., 1904.
Deceased.

Jensen, Walter H., 1910 .... Great Falls, Montana
Secretary-Treasurer Montana Brewing Company.
Johns, John W., 1906 .... Marysville, Montana
Superintendent Shannon Mine, Barnes-King Development Co.
Johnstone, J. Clark, 1909 .... Butte, Montana
Representative Faust Concentrating & Manufacturing Co.

Kane, Edward G., 1909 .... Butte, Montana
Mine Foreman, Bell Mine, A. C. M. Co.
Kane, Louis M., 1906.
Deceased.
Ketcham, S. H., 1908 .... Missoula, Montana
Engineering, Private Practice.
Kirby, Kenneth P., 1909 .... Butte, Montana
Mining Engineer, Anaconda Mine, A. C. M. Co.
Kupahl, Henry E., 1904 .... Boise, Idaho
Assistant State Bridge Engineer.

Lind, A. Leslie, 1916 .... Butte, Montana
With Butte Stove Repair Co.
Ling, Tao, 1917 .... Chias Tso, Honan, China
Dean of Fu-Chung Mining College.
Lomas, E. P., 1908 .... Butte, Montana
President Butte East Slope Mining Co.
Loughran, David L., 1918 .... Butte, Montana
Assistant County Surveyor, Silver Bow County, Montana.
Loughran, M. J., 1909 .... Butte, Montana
County Surveyor, Silver Bow County, Montana.
Lowry, Thomas M., 1909 .... San Francisco, Cal.
Geological Department, Standard Oil Co.
Lyden, Joseph P., 1914 .... Butte, Montana
Geologist, A. C. M. Co.

Lyon, Thomas T., Jr., 1916..........Butte, Montana
Geologist, A. C. M. Co.

McAuliffe, D. C., 1920..........Miles City, Montana
Athletic Director & Instructor of Mathematics, Custer County High School.

McCool, Edward J., 1913..........Butte, Montana
Safety & Ventilation Engineer, A. C. M. Co.

McCracken, Ralston H., 1907..........Philipsburg, Montana
Mining Engineer Philipsburg Mining Co.

McElvenny, L. T., 1911..........Butte, Montana

McGee, John, 1904..........Tonopah, Nevada
General Manager Water Company of Tonopah.
General Manager Great Western Consolidated Mining Co.

McLaughlin, William D., 1908..........Butte, Montana
Surveyor, Tramway Mine, A. C. M. Co.

McMahon, Brandon P., 1914..........Butte, Montana
Asst. Engineer, Original Mine, A. C. M. Co.

Mackel, Louis C., 1905..........Santa Fe, New Mexico
Mineral Examiner, General Land Office.

MacPherson, Frank H., 1914..........Butte, Montana
Assistant City Engineer.

MacRae, L. D., 1904..........Nacozari, Sonora, Mexico
Engineer, Moctesuma Copper Company.

Malloy, Emmett E., 1909..........Butte, Montana
Land Classifier and Appraiser.

Manwaring, Joseph H., 1913..........Butte, Montana
Sampler, Leonard Mine, A. C. M. Co.

Mason, Veyne V., 1916..........Butte, Montana
Testing Engineer, A. C. M. Co.

Meiklejohn, Archie B., 1908..........Los Angeles, Cal.
Operating Accountant, Southern California Edison Co.

Milkwick, C. F., 1919..........Anaconda, Montana
Chemist, Washoe Smelter, A. C. M. Co.

Mueller, Ernest, 1920..........Butte, Montana
Sampler Leonard Mine, A. C. M. Co.

Murphy, James Kane, 1911.
Deceased.

Murphy, Joseph G., 1914..........El Paso, Texas
Sales Manager, Worthington Pump & Machinery Corporation.

Nelson, A. S., 1918..........Leadwood, Missouri
Testing Engineer, St. Joseph Lead Company.

Newton, Claude O., 1919..........Placerville, California
Engineer, Western States Gas and Electric Co.

Norton, John E., 1917..........Butte, Montana
Safety Engineer Mountain View Mine, A. C. M. Co.

O'Brien, Albert, 1908..........Butte, Montana
Mining Engineer.

O'Connor, Charles H., 1911..........Palmer, Kings County, Wash.
O'Donnell, Neil, 1921..........Murray, Idaho
Assistant Resident Manager Yukon Gold Company.

Parker, W. Howard, 1917.
Deceased.
Patten, Earle B., 1908..........Philipsburg, Montana
Mining Engineer & County Surveyor Granite County, Montana.
Pauley, P. L., 1904..........Butte, Montana
Draftsman Timber Butte Milling Company.
Peter, Ida B., 1909..........Santa Barbara, California
Branch Manager, Los Angeles Times.
Peterson, P. E., 1911..........Nainaimo, B. C., Canada
Superintendent of Coal Washeries, Western Fuel Co.
Petritz, William E., 1918..........Butte, Montana
Shift Boss Reins Mine, A. C. M. Co.
Pierce, Wilbur C., 1919..........Great Falls, Montana
Chemist and Assayer, General Lab., A. C. M. Co.
Pierse, Edwin A., 1913..........Bad Axe, Michigan
Sales Manager Automotive Sales and Service Co.
Pilger, Theodore, 1912..........New York, N. Y.
Sales Engineer, Allis-Chalmers Manufacturing Co.
Pratt, A. F., 1913..........Portland, Oregon
Pratt, Paul D., 1905..........Helena, Montana
Member of the firm of Western Construction Company, General Contractors.
Proctor, M. D., 1908..........Truly, Montana
McNair & Proctor Ranch Co.
Proctor, I. O., 1908..........Radersburg, Montana
President and Manager Proctor Leasing Co.

Reardon, D. J., 1907..........Butte, Montana
Member of the firm of Medin & Co., General Contractors.
Reber, Bert A., 1915..........North Columbia, Cal.
Reese, Mrs. Clara Clark, 1904..........Los Angeles, Cal.
Reid, Milton A., 1913..........Butte, Montana
Chief Chemist, Washoe Sampler.
Renouard, Edward L., Jr., 1920..........Butte, Montana
Engineering Department, A. C. M. Co.
Roach, James, 1911.
Deceased.
Rowe, A. Arnold, 1921..........Butte, Montana
Chemist, Butte & Superior Mining Co.

Schaefer, W. A., 1907.
Deceased.
Schiffner, O. E., 1908..........Reno, Nevada
General Superintendent Standard Metals Company.
Sheedy, John W., 1915..........Hurley, New Mexico
Flotation Foreman, Chino Copper Company.

Shields, E. Floyd, 1911 .... Butte, Montana
Asst. Manager Crystal Copper Co., operating mines at Butte, Basin and Marysville.

Sparks, Karl T., 1917 .... Fairbanks, Alaska
Mining Engineer, U. S. Bureau of Mines.

Steele, C. H., 1916 .... Butte, Montana
Geologist, A. C. M. Co.

Stevenson, Isabel Little, 1904 .... Richmond, Virginia
Clerk, Credit Department, Federal Reserve Bank.

Stevenson, L. C., 1905.
Deceased.

Stockett, Norman A., 1909 .... Bonne Terre, Missouri
Engineer St. Joseph Lead Co.

Strang, Willis B., 1916 .... Everett, Washington
With Woolworth 5c, 10c and 15c Store.

Stuewe, William, Jr., 1910 .... Spokane, Washington
Sales & Structural Engineer, Minneapolis Steel & Machinery Co.

Sultzer, H. Duke, 1911 .... Butte, Montana
Ventilation and Safety Engineer, Tramway Mine, A. C. M. Co.

Tallant, Harry S., 1904 .... Palma Sola, Florida
Farmer.

Taylor, Maurice H., 1921 .... Butte, Montana
Sampler, Steward Mine, A. C. M. Co.

Ternouth, Blaine, 1914 .... San Francisco, Cal.
Foreman, W. J. Benson Company.

Thrasher, Willard, 1918 .... Butte, Montana
Sampler Never Sweat Mine, A. C. M. Co.

Tout, Charles, 1911 .... Cardwell, Montana
Mining Engineer Liberty Montana Mines Company.

Tseo, G. B., 1917 .... Nanchong, Kiangse, China
Mining Director of the Industrial & Mining Bureau of Kiangse.

Van Gundy, Jay E., 1905 .... Casper, Wyoming
Chief Engineer, The Ohio Oil Company.

Vaupell, C. W., 1920 .... Socorro, New Mexico
Assistant Professor Department of Geology, New Mexico School of Mines.

Villars, Jesse R., 1908 .... Great Falls, Montana
Oil and Mining Geologist.

Vivian, George F., 1917 .... Butte, Montana
Chief Sampler, A. C. M. Co.

Walton, Lee M., 1908 .... Great Falls, Montana
Manager Wardrobe Company.

Warfield, H. J., 1906 .... Los Angeles, California
Investments, United Theaters & Motion Pictures Productions.

Watson, Robert M., 1915.
Deceased.

Werelius, Walter R., 1921 .... Elkhorn, Jefferson County, Montana
In partnership operating small mine and mill.

Whealdon, Alfred N., 1921..........Portland, Oregon
Mineral Examiner, General Land Office.

Wiegenstein, H. J., 1909..........Butte, Montana
Commissioner of Public Works, Butte, Montana.

Wilkinson, Thomas H., 1917..........Butte, Montana
Assistant Foreman Reins Mine, A. C. M. Co.

Williams, Paul K., 1912..........Butte, Montana

Wilson, Curtis L..........Butte, Montana
Instructor of Metallurgy, Montana State School of Mines.

Wilson, T. Bert, 1906..........Goldendale, Washington
Manager Goldendale Garage.

Wong, Samuel C., 1916..........Shanghai, China
Construction Engineer, Standard Oil Company.

Woodworth, T. Guy, 1915..........Butte, Montana
Geologist, A. C. M. Co.

Wren, Andrew A., 1908..........Patagonia, Arizona
Superintendent Patagonia Superior Mining Co.

Young, Arthur B., 1906..........Canaille, Arizona
Forestry Service, U. S. Dept. of Agriculture.

Young, S. A., 1906..........Seaside, Oregon
Private Practice.

Young, William A., 1909..........Maiden, Montana
Lessee Maginnis Mine.

Zentner, Arthur A., 1911..........Helena, Montana
Research Engineer, East Helena Plant, A. S. & R. Co.

Register of Alumni by Classes

1903

L. V. Bender.

1904

A. J. Balmforth, Clara Clark (Roose), J. F. Duhling, Arthur L. Irelan, Henry E. Kupahl, Isabel Little (Stevenson , L. D. MacRae, John McGee, P. L. Pauley, H. S. Tallant.

1905

George Archibald, O. F. Brinton, Clarence R. Corey, J. M. Duthie, Basil Elford, L. C. Mackel, P. D. Pratt, L. C. Stevenson, Jay Van Gundy.

1906

J. F. Dugan, Charles W. Feeney, Herbert S. Gieser, John W. Johns, Louis N. Kane, Hershel J. Warfield, Bert T. Wilson, S. A. Young, Arthur B. Young.

1907

Arthur E. Adami, Clifford A. Bovett, Ralston H. McCracken, Daniel Reardon, W. A. Schafer.

1908

Malcolm Bowden, Willis H. Ellis, Frank A. Foote, S. H. Ketcham, E. P. Lomas, T. M. Lowry, William D. McLaughlin, Archie B. Meiklejohn, Albert O'Brien, Earle B. Patten, I. O. Proctor, M. D. Proctor, Otto E. Schiffner, Jesse R. Villars, Lee M. Walton, A. A. Wren.

1909

William Brulo, James R. Evans, Ralph Gilham, Peter A. Haines, J. Clark Johnstone, Edward G. Kane, Kenneth P. Kirby, Michael Loughran, Emmett E. Malloy, Ira B. Peters, Norman A. Stockett, Henry J. Wiegenstein, William A. Young.

1910

August Grunert, Walter H. Jensen, William Steuwe, Jr.

1911

R. S. Clinch, L. T. McElvenny, James K. Murphy, C. H. O'Connor, P. E. Peterson, James Roach, E . Floyd Shields, H. D. Sultzer, Charles Tout, Arthur A. Zentner.

1912

J. T. Andrew, Arthur F. Bassett, Otto B. Christian, Walter D. Clinch, Jesse E. Cohan, Hamilton Cooke, Jr., Emmet R. Cullity, Geo. M. Fowler, Murl H. Gidel, Ettore Giovanetti, Charles Grupe, Theo. F. Pilger, Paul K. Williams.

1913

Zar T. Crittenden, Chris G. Dobson, Wilbur W. Hanson, Edw. J. McCool, Joe H. Manwaring, Lucian Newton, Edwin A. Pierse, A. F. Pratt, Milton A. Reid.

1914

Robt. J. Cole, Joseph P. Lyden, Brandon McMahon, Frank H. MacPherson, Joseph G. Murphy, Blaine Ternouth.

1915

Peter A. Aline, Luther T. Goodell, John E. Hunt, Bert A. Reber, John W. Sheedy, Robert A. Watson, Guy T. Woodworth.

1916

F. R. Curran, William J. Hill, Eugene Hogan, A. Leslie Lind, Thomas T. Lyon, Jr., Veyne V. Mason, Chester H. Steele, Willis B. Strang, S. A. Wong.

1917

Frank D. Cannon, Stanley B. Carlisle, T. C. Cheung, Thomas F. Collins, Herman Freshman, Fred P. Gaethke, Tao Ling, John E. Norton, Howard Parker, Karl T. Sparks, G. B. Theo, George F. Vivian, Thomas Wilkinson.

1918

David E. Loughran, A. S. Nelson, William E. Petritz, Willard Thrasher.

1919

Edward F. Courtney, A. L. Engel, Clifford F. Milkwick, Claude O. Newton, Wilbur C. Pierce.

1920

Frank M. Cliff, Emmett Hale, D. Charles McAuliffe, Ernest Mueller, Edw. I. Renouard, Jr., C. W. Vaupell, Curtis L. Wilson.

1921

Julius Amberson, C. A. Fredell, Neil A. O'Donnell, Francis A. Rowe, Maurice H. Taylor, Walter R. Werelius, Alfred N. Whealdon.

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